

School of Technology, Environments and
Design

***Safe Food Management and Smartphone Technology:
An Investigation into the Impact of Information
Modalities on Consumer Knowledge Acquisition,
Retention and Perception of Capacity for Behavioural
Change***

By

Adeola Bamgboje-Ayodele,
Msc IT, BTech. Comp (Hons)

A dissertation submitted in fulfilment of the requirements for the degree
of
Doctor of Philosophy

University of Tasmania

May, 2017

I. STATEMENT OF ORIGINALITY

This dissertation contains no material which has been accepted for the award of the degree of diploma by the University of Tasmania or any other institution, except by way of background information and duly acknowledged in the thesis, and to the best of the candidate's knowledge and belief, no material previously published or written by another person except where due acknowledgement is made in the text of the thesis.

Date: 17th May, 2017

Adeola Bamgboje-Ayodele

II. STATEMENT OF AUTHORITY OF ACCESS

This thesis may be made available for loan and limited copying in accordance with the *Copyright Act 1968*.

Date: 17th May, 2017

III. STATEMENT OF CO-AUTHORSHIP

The following people and institutions contributed to the publication of work undertaken as part of this thesis:

Adeola Bamgboje-Ayodele,
School of Technology, Environments and Design
University of Tasmania

Candidate

Associate Professor Leonie Ellis
School of Technology, Environments and Design
University of Tasmania
Primary Supervisor

Author 1

Associate Professor Paul Turner
School of Technology, Environments and Design
University of Tasmania
Co-Supervisor

Author 2

Author details and their roles:

Paper 1

Located in Chapters 1 and 2

Bamgboje-Ayodele, A., Ellis, L., Turner, P., 2014. Identifying key Research Challenges in Investigating Knowledge Optimization Strategies in Perishable Food Chains, Proceedings of the 11th International Conference on Intellectual Capital, Knowledge Management and Organisational Learning: ICICKM2014, p. 48.

Candidate was the primary author and with author 1 and author 2 contributed to the conception and design of the research project and drafted significant parts of the paper. Candidate contributed approximately 60% to the planning, execution and preparation of the work for the paper.

Paper 2

Located in Chapter 4

Bamgboje-Ayodele, A., Ellis, L., Turner, P., 2014. *Empowering Consumers in Food Value Chains: Preliminary Insights from an Investigation into the Development of Tools for Food Safety*, The 25th Australasian Conference on Information Systems (ACIS 2014), Auckland, New Zealand.

Candidate was the primary author and with author 1 and author 2 contributed to the conception and design of the research project and drafted significant parts of the paper. Candidate contributed approximately 60% to the planning, execution and preparation of the work for the paper.

Paper 3

Located in Chapter 4

Bamgboje-Ayodele, A., Ellis, L., & Turner, P. (2015). *Supporting 'Good Habits' through User-Led Design of Food Safety Applications - Findings from a Survey of Red Meat Consumers*. Paper presented at the Australasian Conference on Information Systems, South Australia.

Candidate was the primary author and with author 1 and author 2 contributed to the conception and design of the research project and drafted significant parts of the paper. Candidate contributed approximately 60% to the planning, execution and preparation of the work for the paper.

Paper 4

Located in Chapter 4

Bamgboje-Ayodele, A., Ellis, L., & Turner, P. (2016). A Food Recall Case Study in Australia – Towards the Development of Food Safety Applications for Consumers. *International Journal of Food Studies* 5(1).

Candidate was the primary author and with author 1 and author 2 contributed to the conception and design of the research project and drafted significant parts of the paper. Candidate contributed approximately 60% to the planning, execution and preparation of the work for the paper.

We the undersigned agree with the above stated proportion of work undertaken for each of the above published peer-reviewed manuscripts contributing to this thesis.

Signed:

	<hr/>	<hr/>
	Associate Professor Leonie Ellis	Professor Kirsten Orr
	Primary Supervisor	Head of School
	School of Technology,	School of Technology,
	Environments and Design	Environments and Design
	University of Tasmania	University of Tasmania
Date:	<hr/> 20/06/2018 <hr/>	<hr/> 21/06/2018 <hr/>

IV. ABSTRACT

This thesis investigates how the affordances of smartphone technology can be leveraged to enhance the provision of consumer food safety management information and facilitate knowledge retention amongst consumers to support safe food behaviours. This research integrates, within a mobile food safety application, insights from a heuristic framework, a consumer-based usability evaluation and best practice information on safe food management (**SFM**) from relevant government agencies in Australia. This research directly contributes to understanding of the influence of technology on consumers' knowledge acquisition, knowledge retention and perceptions of their capacity for behavioural change.

The research methodology employed a mixed method approach that was underpinned by a subjective ontology and a pragmatist epistemology. The research strategy consisted of a case study, a survey, a usability study and a field experiment, which were embedded in a three phase research design and spanned a period of 16 months. The research design consisted of three phases:

In phase one, the preliminary stage explored the boundaries of domestic food safety by investigating the communication of a food firm that had recently experienced a recall situation, through a case study approach, using semi-structured interviews, field notes and document reviews. As mitigating food safety risks is a major source of concern for government authorities, the food industry and other stakeholders, diverse innovative mechanisms focused on monitoring and controlling production processes across supply chains, such as ISO22000 (Varzakas and Arvanitoyannis, 2008), HACCP control systems (Unnevehr and Jensen, 1999), HARPC control systems (Grover et al., 2016), and traceability systems (Regattieri et al., 2007), have been employed to address many of these risks. In this phase, it was revealed that these food safety mechanisms are largely focused on supply chain activities from '*paddock-to-purchase*' (pre-purchase) as the legal obligations of supply chain partners on food safety tends to be completed once consumers purchase the products (Bamgboje-Ayodele et al., 2016). Thus, mitigating food safety risks during the process of consumption (post-purchase), which entails domestic food management and handling from the point of purchase (purchase) to the point of actual consumption (plate), is largely the responsibility of consumers.

With this focus on consumers, phase one also explored the food handling practices of consumers to identify knowledge gaps on safe food management through a survey of 217 participants living in Australia drawn from the database of an ISO certified consumer panel. Although, the widespread incidence of food poisoning outbreaks through domestic food mismanagement from ‘purchase-to-plate’ is not a new phenomenon; the diversity of consumer characteristics has made finding effective solutions very difficult to address. For example; the varying degree of food safety knowledge of consumers has facilitated many public food safety information campaigns and awareness programs (Verbeke et al., 2007). Despite these efforts, many consumers remain inadequately informed about food safety and continue to engage in unsafe food handling practices. In this phase, it was revealed that consumers particularly had poor knowledge on safe cooking, safe storage and kitchen hygiene. Having identified these knowledge gaps in this phase, there was a need to empower consumers to acquire and retain the knowledge.

With the recent advancement in ICT, one of the easiest and most useful means of informing consumers is through mobile technology due to its pervasiveness. More specifically, through the use of smartphones (Duan et al., 2014), as they provide users with the ability to engage with their phones like a traditional personal computer that is connected to the internet and other data networks with the advantage of portability and mobility (Luxton et al., 2011). This results in a highly personalised nature of smartphones as they embody a user-empowering characteristic (Tossell et al., 2012), thus providing users with an array of capabilities and experiences that are tailored to their interests. One way to demonstrate such level of personalization is the ability to allow users to download diverse mobile applications or ‘apps’ onto their smartphones (Jung, 2014) which affords consumers the opportunity to inform themselves about specific areas of interests such as safe food handling practices.

However, evidence suggests that existing food apps have three key limitations. First, they provide information in silos in relation to the various aspects of domestic SFM for Australian consumers, thus resulting in lack of continuity from one food handling stage to the other. Second, there is insufficient evidence that existing apps have drawn upon information modality studies (Mayer, 2009) which suggest that textual (Blanco et al., 2010), visual (Ha and Lennon, 2010), verbal (Kim and Lennon, 2008) or integrated

information influence consumer behaviour pre-purchase. Third, there is insufficient evidence to validate that existing apps were developed based on frameworks guiding mobile health consumer apps, thus questioning whether best practice guidelines were adhered to. To address these three areas, there was a need to design and develop a safe food management smartphone app in this study in a way that targets the identified knowledge gap areas in phase one by;

- Acquiring insights from relevant government authorities about information that encompasses all the various aspects of domestic SFM for Australian consumers;
- Conducting heuristic and consumer-based usability evaluations on existing food apps with different information modalities to provide insights into how they influence consumer responses post-purchase;
- Incorporating a validated health literacy online heuristic (HLOH) framework in the design of the SFM smartphone app;
- And by evaluating the influence of the app integrating these insights and principles on consumers' knowledge acquisition, knowledge retention and perceived behavioural change, as conducted in this research.

Phase two involved the conduct of a heuristic evaluation of three (text-based app, audio-visual app and integrated app) currently available SFM apps that address the target food handling practice, based on Monkman and Kushniruk's (2013) HLOH framework. These three apps were selected using the following criteria: it must be focused on end-consumers not professional food handlers; it must contain the appropriate meat cooking temperature and cooking time; and it must be given a minimum of 4 out of 5 star rating. User experiences with the three apps were then investigated through a consumer level evaluation with nine participants, based on quantitative and qualitative information tasks conducted in a focus group session. In this phase, the outcome of both the heuristic and consumer evaluations reveal important lessons that were learnt from the existing apps and incorporated into the design and development of the SFM app.

Phase three involved the implementation of the SFM app and the evaluation of the impact of the app on eight participants. In this phase, baseline data was collected on the participants' level of knowledge; they were involved in a 4-week field experiment using

scenarios where they used the app and where they did not use the app. During this time, data was collected using open and closed questionnaires. Six-weeks after the experiment, the participants were questioned to investigate their perceived knowledge retention and behavioural changes.

The findings reveal that the app induced a higher level of extraneous cognitive load, thus placing a level of demand on the working memory and this resulted in requiring more time to achieve knowledge acquisition. However, it also reveals that the time a learner spends in using the safe food management app which contained visualizations with spoken and integrated text during the information and knowledge acquisition phase may be advantageous in facilitating knowledge retention for a longer period of time than traditional information delivery techniques. In addition, it reveals that skills and attributes of consumers influence how they respond to the safe food management app due to their perceived personal relevance, their individual differences moderating adult learning and their orientation towards cognition.

The key findings that emerged are as follows;

- Multiple modalities are effective in delivering safe food management information to influence knowledge retention when the information delivery tool is designed based on principles derived from an enhanced version of Monkman and Kushniruk's (2013) HLOH framework.
- The safe food management (SFM) app requires more time to be spent to achieve knowledge acquisition which resulted in retaining the knowledge for a longer period of time than the traditional information delivery techniques.
- Smartphone apps induce some level of cognitive load in adoption however; the affordance of its reuse for quick but infrequent revisitations facilitates knowledge retention.
- The use of a modified user centred design approach, using a heuristic framework with consumer evaluation outputs as a basis for app development, can support the development of a safe food management app.
- Food related behaviour is intimately linked to the individual's attributes, habit, knowledge and context of use as the provision of safe food management information

does not necessarily result into its use, corresponding knowledge or expected behaviour.

This research has made a number of contributions at substantive, methodological and theoretical levels. At a substantive level, this research provides insights into how the affordances of smartphones can be leveraged to enhance consumer SFM knowledge in an attempt to improve the food management behaviour of Australian consumers. At a methodological level, the research was designed in such a way that the subject area was first explored in phase one, to refine the research area. In addition, the research tested an existing usability framework in phase two and conducted practical field evaluation in phase three. Furthermore, the research employed a non-conventional software methodology by utilising a modified user centred design approach using a heuristic framework combined with consumer evaluation outputs, as a basis for app development. At a theoretical level, this research has provided insights into additional principles that should be combined with Monkman and Kushniruk (2013) HLOH framework when designing a SFM app; thus providing design insights for Information Systems researchers that aim to develop apps that provide information on SFM.

V. ACKNOWLEDGEMENTS

I gratefully acknowledge the support and guidance provided by my team of supervisors – Associate Professor Leonie Ellis and Associate Professor Paul Turner. I appreciate your support, inspiration, and constructive criticisms throughout the course of my candidature which has made me evolve over the years, while making the journey an interesting one. I would specially like to thank my primary supervisor, Dr Leonie Ellis for her encouragements, continuous assistance, mentorship and dedication while undertaking this PhD.

To my ever-patient husband, Ayodeji, I certainly would not have started this journey, neither would I have completed it, without your constant motivation, unwavering support, kindness, understanding and prayers. Thanks to my gorgeous son, Luke, for all the smiles and giggles, which are always comforting and encouraging. To my dad, mum, siblings and in-laws, I appreciate your support and understanding. To my father in the Lord, I appreciate your words of encouragement, advice and prayers. I thank you all for your continuous support.

I specially thank my app developers, Ayodeji Ayodele and Jon Manning for their kind assistance in the development of the Android and iOS versions of the research tool used in this study. I appreciate all my research participants, for their time and dedication towards the successful completion of my research. I also acknowledge the financial support received from the Australian Government Research Training Program Scholarship, the Association of Computing Machinery for Women (ACM-W) and the ARC's Pathway to Market project. I am thankful for the support of the following agencies;

- Commonwealth Scientific and Industrial Research Organisation (CSIRO)
- Food Safety Information Council (FSIC)
- Food Standards Australia New Zealand (FSANZ)
- Meat and Livestock Australia (MLA)
- New South Wales Food Authority (NSWFA)

I would also like to thank my senior colleagues, Erin, Ming Chao and Luke, for making me understand my supervisors better and for their continuous support and friendship. I specially appreciate Erin and Ming Chao for reading through the early drafts of this

thesis and for assisting with the experiment. To my past and current PhD colleagues, my friends, and office mates Songlak, Michelle, Leila, Helen, Nadish, Kritcha, Anwar, David and Mazzino, thanks for your friendship.

I also appreciate the valuable feedback from my anonymous referees from the following journals and conferences. I would also like to acknowledge the contributions made by my co-authors in these publications.

- Bamgboje-Ayodele, A., Ellis, L., Turner, P., 2014. Identifying key Research Challenges in Investigating Knowledge Optimisation Strategies in Perishable Food Chains, Proceedings of the 11th International Conference on Intellectual Capital, Knowledge Management and Organisational Learning: ICICKM2014, p. 48.
- Bamgboje-Ayodele, A., Ellis, L., Turner, P., 2014. Empowering Consumers in Food Value Chains: Preliminary Insights from an Investigation into the Development of Tools for Food Safety, The 25th Australasian Conference on Information Systems (ACIS 2014), Auckland, New Zealand.
- Bamgboje-Ayodele, A., Ellis, L., & Turner, P. (2015). Supporting 'Good Habits' through User-Led Design of Food Safety Applications - Findings from a Survey of Red Meat Consumers. Paper presented at the Australasian Conference on Information Systems, South Australia.
- Bamgboje-Ayodele, A., Ellis, L., & Turner, P. (2016). A Food Recall Case Study in Australia – Towards the Development of Food Safety Applications for Consumers. International Journal of Food Studies.

Finally, I will like to dedicate this research to the Almighty God, who has made me attain this height. Thanks be to God.

VI. GLOSSARY OF TERMS

App	Smartphone Application
CB	Consumer Behaviour
eWOM	electronic Word of Mouth
FOMO	Fear of Missing Out
FS	Food Safety
HCI	Human Computing Interaction
HLOH	Health Literacy Online Heuristics
ICTs	Information and Communication Technologies
IM	Information Management
InA	Integrated App
IS	Information Systems
KM	Knowledge Management
PDAs	Personal Digital Assistants
PTA	Picture and Text-based App
RFID	Radio Frequency Identification
RSS	Really Simple Syndication
SFM	Safe Food Management
SIM	Subscriber Identity Module
TbA	Text-based App
VMD	Visual Merchandising

VII. TABLE OF CONTENTS

I.	STATEMENT OF ORIGINALITY.....	II
II.	STATEMENT OF AUTHORITY OF ACCESS.....	III
III.	STATEMENT OF CO-AUTHORSHIP	IV
IV.	ABSTRACT	VI
V.	ACKNOWLEDGEMENTS	XI
VI.	GLOSSARY OF TERMS	XIII
VII.	TABLE OF CONTENTS.....	XIV
VIII.	LIST OF TABLES	XXI
IX.	LIST OF FIGURES	XXIII
1	INTRODUCTION.....	2
1.1	RESEARCH DOMAIN	3
1.2	RESEARCH PROBLEM	6
1.2.1	<i>Research Aim</i>	10
1.2.2	<i>Research Questions and Objectives</i>	10
1.2.3	<i>Research Approach</i>	11
1.3	SUMMARY OF CONTRIBUTIONS	13
1.4	OVERVIEW OF THE THESIS	14
1.4.1	<i>Chapter 2 - Literature Review</i>	14
1.4.2	<i>Chapter 3 – Methodology</i>	15
1.4.3	<i>Chapter 4 – Data Analysis and Preliminary Findings: Investigating Knowledge Gaps</i>	15
1.4.4	<i>Chapter 5 – Data Analysis and Preliminary Findings: Design and Development of the Safe Food Management App</i>	16
1.4.5	<i>Chapter 6 – Data Analysis and Preliminary Findings: Implementing and Evaluating the Safe Food Management App</i>	16
1.4.6	<i>Chapter 7 – Answering the Research Questions – Key Findings</i>	17
1.4.7	<i>Chapter 8 – Conclusion</i>	17
1.5	CHAPTER SUMMARY	17
2	LITERATURE REVIEW	20
2.1	AN INTRODUCTION TO KNOWLEDGE MANAGEMENT (KM).....	21
2.1.1	<i>Information Management and Knowledge Management</i>	21
2.1.2	<i>Knowledge Optimisation</i>	24
2.1.3	<i>Critical Reflections on Section 2.1</i>	29
2.2	INFORMATION AND COMMUNICATION TECHNOLOGIES (ICTs)	30
2.2.1	<i>The Pervasiveness of ICT</i>	30

2.2.2	<i>Mobile Computing</i>	32
2.2.3	<i>Usability and Health Literacy</i>	40
2.2.4	<i>Critical Reflections on Section 2.2</i>	42
2.3	CONSUMER BEHAVIOUR.....	43
2.3.1	<i>Introduction to Consumer Behaviour</i>	43
2.3.2	<i>Communication: An Information Modality Perspective</i>	44
2.3.3	<i>Consumer Information Seeking Behaviour</i>	49
2.3.4	<i>Consumer and Food Information Processing Peculiarities</i>	50
2.3.5	<i>Consumer Food Behaviour</i>	51
2.3.6	<i>Risk Perception, Risk Communication and ICT</i>	55
2.3.7	<i>Critical Reflections on Section 2.3</i>	60
2.4	FOOD SAFETY: AN IT PERSPECTIVE.....	61
2.4.1	<i>An Introduction to the Food Chain</i>	62
2.4.2	<i>Food Safety</i>	64
2.4.3	<i>Regulatory Solutions to Food Safety Issues</i>	66
2.4.4	<i>Safe Food Management: A Consumer Perspective</i>	70
2.4.5	<i>Critical Reflections on Section 2.4</i>	79
2.5	CHAPTER SUMMARY	80
3	METHODOLOGY	84
3.1	INTRODUCTION	84
3.2	RESEARCH PHILOSOPHY	85
3.2.1	<i>Ontology</i>	85
3.2.2	<i>Epistemology</i>	86
3.2.3	<i>Mixed Method Research Methodology</i>	87
3.3	RESEARCH STRATEGY	91
3.3.1	<i>The Case Study Strategy</i>	91
3.3.2	<i>The Usability Study Strategy</i>	92
3.3.3	<i>Field Experiment</i>	94
3.3.4	<i>Three Phase Data Collection</i>	103
3.4	RESEARCH DESIGN.....	105
3.5	TOOLS AND TECHNIQUES	111
3.5.1	<i>Semi-Structured Interviews</i>	113
3.5.2	<i>Focus Groups</i>	113
3.5.3	<i>Document Review</i>	113
3.5.4	<i>Field Notes</i>	114
3.5.5	<i>Card Sorting Technique</i>	115
3.5.6	<i>Survey or Questionnaire</i>	115
3.5.7	<i>Ethics</i>	121
3.6	DATA ANALYSIS	122

3.6.1	<i>Theory of Analysis – Quantitative</i>	122
3.6.2	<i>Theory of Analysis – Qualitative</i>	122
3.6.3	<i>Analytical Approach</i>	123
3.7	DATA DISCUSSION AND INTERPRETATION	123
3.8	CHAPTER SUMMARY	125
4	DATA ANALYSIS AND PRELIMINARY FINDINGS: INVESTIGATING KNOWLEDGE GAPS	127
4.1	INTRODUCTION	127
4.2	PRELIMINARY STAGE, PHASE ONE – FIRM PERSPECTIVE	128
4.2.1	<i>Food Recall Incidents in Australia</i>	128
4.2.2	<i>Preliminary Stage, Phase One – Initial Findings</i>	129
4.3	ADVANCED STAGE, PHASE ONE – CONSUMER PERSPECTIVE	132
4.3.1	<i>Demography of the Respondents</i>	133
4.3.2	<i>Analysis of Screening Questions</i>	134
4.3.3	<i>Post Purchase Data Analysis</i>	135
4.3.4	<i>Pre Purchase Data Analysis</i>	166
4.3.5	<i>Information Technology Related Data Analysis</i>	168
4.3.6	<i>Advanced Stage, Phase One – Initial Findings</i>	171
4.4	CHAPTER SUMMARY	172
5	DATA ANALYSIS AND PRELIMINARY FINDINGS: DESIGN AND DEVELOPMENT OF THE SAFE FOOD MANAGEMENT APP	176
5.1	INTRODUCTION	176
5.2	PAPER-BASED TOOL AS A BASELINE	178
5.3	DESIGNING THE SAFE FOOD MANAGEMENT SMARTPHONE APP	178
5.3.1	<i>Existing App Selection</i>	179
5.3.2	<i>Heuristic Evaluation</i>	180
5.3.3	<i>Consumer Based Evaluation - Focus Group Session</i>	181
5.3.4	<i>Card Sorting Technique for the Consumer-Based Evaluation</i>	190
5.3.5	<i>Themes generated from the Consumer-Based Evaluation</i>	197
5.4	INTEGRATING HEURISTIC AND CONSUMER EVALUATION	201
5.5	CONCEPT DESIGN	207
5.6	DEVELOPING THE SAFE FOOD MANAGEMENT APP	207
5.7	PHASE TWO – INITIAL FINDINGS	209
5.8	CHAPTER SUMMARY	212
6	DATA ANALYSIS AND PRELIMINARY FINDINGS: IMPLEMENTING AND EVALUATING THE SAFE FOOD MANAGEMENT APP	215
6.1	INTRODUCTION	215
6.2	DEMOGRAPHY OF THE PARTICIPANTS	217

6.2.1	<i>Smartphone Usage</i>	218
6.2.2	<i>Food Handling</i>	220
6.3	FIELD EXPERIMENT FINDINGS	220
6.3.1	<i>Field Experiment – Week One</i>	220
6.3.2	<i>Field Experiment – Week Two</i>	222
6.3.3	<i>Field Experiment – Week Three</i>	223
6.3.4	<i>Field Experiment – Week Four</i>	226
6.3.5	<i>Post-Experiment Assessment after 6 Weeks</i>	233
6.4	ASSESSING INDIVIDUAL PARTICIPANT DURING AND AFTER THE EXPERIMENT	235
6.4.1	<i>Summary of Vignette 1: Participant ACJ</i>	235
6.4.2	<i>Summary of Vignette 2: Participant ACC</i>	236
6.4.3	<i>Summary of Vignette 3: Participant ACH</i>	236
6.4.4	<i>Summary of Vignette 4: Participant ACM</i>	237
6.4.5	<i>Summary of Vignette 5: Participant DCW</i>	238
6.4.6	<i>Summary of Vignette 6: Participant DCT</i>	239
6.4.7	<i>Summary of Vignette 7: Participant DCV</i>	240
6.4.8	<i>Summary of Vignette 8: Participant DCH</i>	241
6.5	DEMONSTRATING REMEMBRANCE TO EMPHASISE KNOWLEDGE ACQUISITION.....	242
6.6	DEMONSTRATING UNDERSTANDING TO EMPHASISE KNOWLEDGE RETENTION.....	244
6.7	DEMONSTRATING KNOWLEDGE APPLICATION	246
6.8	USAGE OF THE APP OR PAPER-BASED TOOL DURING THE 4-WEEK EXPERIMENT	248
6.9	PHASE THREE – INITIAL FINDINGS	249
6.10	CHAPTER SUMMARY	260
7	ANSWERING THE RESEARCH QUESTIONS – KEY FINDINGS	263
7.1	INTRODUCTION	263
7.2	KEY RESEARCH FINDINGS.....	263
7.2.1	<i>First Key Finding</i>	263
7.2.2	<i>Second Key Finding</i>	270
7.2.3	<i>Third Key Finding</i>	273
7.2.4	<i>Fourth Key Finding</i>	274
7.2.5	<i>Fifth Key Finding</i>	277
7.3	RESEARCH QUESTIONS AND ANSWERS	280
7.3.1	<i>The Extent to which Food Safety Knowledge Gaps exist in Consumers</i>	281
7.3.2	<i>Considerations for Developing a Safe Food Management App to Address Consumers’ Knowledge Gaps</i>	284
7.3.3	<i>Determining the influence of the safe food management app on knowledge acquisition, knowledge retention and perceived behavioural change</i>	288
7.4	CHAPTER SUMMARY	291
8	CONCLUSION.....	295

8.1	INTRODUCTION	295
8.2	SUMMARIZING THE RESEARCH FINDINGS.....	295
8.2.1	<i>Research Question 1 – The Extent to which Food Safety Knowledge Gaps Exist in Consumers</i>	<i>296</i>
8.2.2	<i>Research Question 2 – Considerations for Developing a Safe Food Management App to Address Consumers’ Knowledge Gaps.....</i>	<i>296</i>
8.2.3	<i>Research Question 3 – Determining the influence of the safe food management app on knowledge acquisition, knowledge retention and perceived behavioural change</i>	<i>298</i>
8.3	RESEARCH CONTRIBUTIONS.....	298
8.3.1	<i>Substantive Level.....</i>	<i>299</i>
8.3.2	<i>Methodological Level</i>	<i>300</i>
8.3.3	<i>Theoretical Level.....</i>	<i>301</i>
8.4	RESEARCH LIMITATIONS.....	302
8.4.1	<i>Scope of Research.....</i>	<i>302</i>
8.4.2	<i>Researcher Bias.....</i>	<i>303</i>
8.4.3	<i>Lack of Generalisability</i>	<i>304</i>
8.5	FUTURE RESEARCH	305
8.6	THESIS SUMMARY	306
9	REFERENCES.....	309
10	APPENDIX A - PERSPECTIVES ON CONSUMER FOOD BEHAVIOUR ISSUES: A CONCEPTUAL MAP	343
11	APPENDIX B - POSTER ADVERT FOR EXPERIMENT PARTICIPANT RECRUITMENT	344
12	APPENDIX C – PRE-TEST BASELINE QUESTIONNAIRE	345
13	APPENDIX D - SCENARIO BASED QUESTIONS (POST-TEST 2)	350
14	APPENDIX E – SCENARIO BASED QUESTIONS (POST-TEST 3).....	360
15	APPENDIX F – PRELIMINARY STAGE, PHASE ONE INTERVIEW QUESTIONS.	363
16	APPENDIX G – AN EXAMPLE OF A FIELD NOTE.....	364
17	APPENDIX H – ADVANCED STAGE, PHASE ONE – CONSUMER SURVEY.....	365
18	APPENDIX I – QUESTIONNAIRE FOR FOCUS GROUP PARTICIPANTS	391
19	APPENDIX J – TEXTUAL CONTENTS OF THE SMARTPHONE APP AND PAPER-BASED TOOL	394
20	APPENDIX K – FULL FINDINGS OF HEURISTIC EVALUATION	410
21	APPENDIX L - SCENARIO BASED FOCUS GROUP QUESTIONS (QUANTITATIVE).....	413

22	APPENDIX M – ANSWER SHEET FOR THE QUANTITATIVE INFORMATION TASKS	416
23	APPENDIX N – SCENARIO BASED FOCUS GROUP QUESTIONS (QUALITATIVE).....	418
24	APPENDIX O – ANSWER SHEET FOR QUALITATIVE INFORMATION TASKS ..	419
25	APPENDIX P – EXPERIMENT EXHIBITS FOR EACH TABLE (WEEK 4)	422
26	APPENDIX Q – INFORMATION SHEET FOR EXPERIMENT PARTICIPANTS	425
27	APPENDIX R – INFORMATION SHEET FOR FOCUS GROUP PARTICIPANTS....	427
28	APPENDIX S – FIRST ETHICS APPROVAL	429
29	APPENDIX T – SECOND ETHICS APPROVAL	431
30	APPENDIX U – THIRD ETHICS APPROVAL	433
31	APPENDIX V – ANALYSIS OF PHASE TWO FINDINGS	435
32	APPENDIX W - THEMES GENERATED FROM THE CONSUMER-BASED EVALUATION.....	447
	<i>32.1.1 Access</i>	<i>447</i>
	<i>32.1.2 Content</i>	<i>449</i>
	<i>32.1.3 Design.....</i>	<i>452</i>
	<i>32.1.4 Search.....</i>	<i>456</i>
33	APPENDIX X – CONCEPT DESIGN.....	458
	<i>33.1.1 App Content.....</i>	<i>458</i>
	<i>33.1.2 App Platforms.....</i>	<i>458</i>
	<i>33.1.3 Home Screen.....</i>	<i>458</i>
	<i>33.1.4 Preparation or Cooking Information.....</i>	<i>459</i>
	<i>33.1.5 Important Safe Preparation Tips</i>	<i>461</i>
	<i>33.1.6 Guide to Correct Cooking Temperatures</i>	<i>462</i>
	<i>33.1.7 Special Rules for Barbecues</i>	<i>463</i>
	<i>33.1.8 Specific Cooking Help</i>	<i>464</i>
	<i>33.1.9 Reheating Leftovers</i>	<i>465</i>
	<i>33.1.10 Meat Thermometers.....</i>	<i>468</i>
34	APPENDIX Y – DETAILS OF FIELD EXPERIMENT RESULTS IN WEEK 3.....	476
35	APPENDIX Z – DETAILS OF FIELD EXPERIMENT RESULTS IN WEEK 4.....	484
36	APPENDIX AA – DETAILS OF THE DATA ANALYSIS.....	493
	<i>36.1.1 Theory of Analysis – Quantitative</i>	<i>493</i>
	<i>36.1.2 Theory of Analysis – Qualitative</i>	<i>495</i>

36.1.3	<i>Analytical Approach</i>	498
37	APPENDIX AB - QUESTIONNAIRE	508
37.1	DEMOGRAPHY OF THE PARTICIPANTS	508
37.2	SMARTPHONE USAGE.....	509
37.3	MEAT RELATED QUESTIONS.....	512
38	APPENDIX AC - ASSESSING INDIVIDUAL PARTICIPANT DURING AND AFTER THE EXPERIMENT	514
38.1.1	<i>Vignette 1: Participant ACJ</i>	514
38.1.2	<i>Vignette 2: Participant ACC</i>	516
38.1.3	<i>Vignette 3: Participant ACH</i>	519
38.1.4	<i>Vignette 4: Participant ACM</i>	521
38.1.5	<i>Vignette 5: Participant DCW</i>	524
38.1.6	<i>Vignette 6: Participant DCT</i>	526
38.1.7	<i>Vignette 7: Participant DCV</i>	529
38.1.8	<i>Vignette 8: Participant DCH</i>	532
39	APPENDIX AD – MORE DETAILS ON TOOLS AND TECHNIQUES	536
39.1	SEMI-STRUCTURED INTERVIEWS.....	536
39.2	FOCUS GROUPS	537
39.3	DOCUMENT REVIEWS.....	539
39.4	CARD SORTING	539
39.5	SURVEY OR QUESTIONNAIRES.....	540

VIII. LIST OF TABLES

TABLE 2-1: SMARTPHONE AFFORDANCES.....	34
TABLE 2-2: FOOD CONSUMER CATEGORIES.....	52
TABLE 2-3: AUSTRALIAN FOOD CONSUMER CATEGORY.....	54
TABLE 2-4: A SUMMARY OF FOOD-RELATED INFORMATION FOR CONSUMERS	58
TABLE 2-5: A SUMMARY OF INFORMATION DELIVERY CHANNELS	59
TABLE 2-6: A SUMMARY OF FOOD-RELATED INFORMATION SOURCES.....	60
TABLE 2-7: PECULIARITIES OF THE FOOD CHAIN	62
TABLE 2-8: DETAILED OVERVIEW OF THE TECHNICAL ISSUES IN TRACEABILITY TECHNOLOGY	69
TABLE 3-1: AN EXAMPLE OF STRATIFIED RANDOMIZATION OUTCOME.....	98
TABLE 3-2: DETAILS OF FIELD EXPERIMENT PROCEDURE	101
TABLE 3-3: RESEARCH INSTRUMENT SOURCE	117
TABLE 4-1: CONTINGENCY TABLE FOR POINT OF PURCHASE AND SHOPPING TIME.....	136
TABLE 4-2: CHI-SQUARE TEST OF ASSOCIATION FOR POINT OF PURCHASE AND SHOPPING TIME	136
TABLE 4-3: CONTINGENCY TABLE FOR SHOPPING TIME AND TRANSPORTATION TIME	138
TABLE 4-4: CHI-SQUARE TEST OF ASSOCIATION FOR SHOPPING TIME AND TRANSPORTATION TIME	138
TABLE 4-5: CONTINGENCY TABLE FOR TRANSPORTATION TIME AND MEAT PACKAGING.....	139
TABLE 4-6: CHI-SQUARE TEST OF ASSOCIATION FOR TRANSPORTATION TIME AND MEAT PACKAGING	139
TABLE 4-7: SUMMARY OF FINDINGS ON FRYING TIME	154
TABLE 4-8: GLOVE USER AND SIMULTANEOUS COOKING	160
TABLE 4-9: CHI SQUARE TEST OF ASSOCIATION FOR GLOVE USER AND SIMULTANEOUS COOKING	160
TABLE 4-10: PRE-PURCHASE ATTRIBUTE PREFERENCES.....	166
TABLE 4-11: PRE-PURCHASE LABEL PREFERENCES	167
TABLE 4-12: THREE MOST PREFERRED LABELS	167
TABLE 4-13: INFORMATION PRESENTATION FORMAT	168
TABLE 4-14: APP'S VISUAL PROPERTIES	169
TABLE 4-15: COMMENTS ON APP DESIGN REQUIREMENTS.....	170
TABLE 4-16: INFORMATION COMMUNICATION CHANNELS	170
TABLE 5-1: SUMMARY OF HEURISTICS EVALUATION OF THE THREE APPS	180
TABLE 5-2: QUANTITATIVE INFORMATION TASK – TBA APP.....	182
TABLE 5-3: QUANTITATIVE INFORMATION TASK – PTA APP.....	184
TABLE 5-4: QUANTITATIVE INFORMATION TASK – INA APP	186
TABLE 5-5: QUALITATIVE INFORMATION TASK – TBA APP	187
TABLE 5-6: QUALITATIVE INFORMATION TASK – PTA APP	188
TABLE 5-7: QUALITATIVE INFORMATION TASK – INA APP	189
TABLE 5-8: LESSONS LEARNT FROM EXISTING APP ISSUES	194
TABLE 5-9: LESSONS LEARNT FROM EXISTING APP BENEFITS	197
TABLE 5-10: CONSUMER EVALUATION GENERATED DEVELOPMENT CONSIDERATIONS.....	200

TABLE 5-11: INTEGRATING CONSUMER EVALUATION FINDINGS WITH MONKMAN AND KUSHNIRUK’S FRAMEWORK	201
TABLE 5-12: COMPARING FINDINGS BETWEEN HEURISTIC EVALUATION AND CONSUMER EVALUATION	203
TABLE 5-13: HEURISTICS EVALUATION GENERATED DESIGN CONSIDERATIONS	207
TABLE 6-1: EXPERIMENTAL GROUP (APP USERS).....	217
TABLE 6-2: CONTROL GROUP (DOCUMENT USERS).....	218
TABLE 6-3: APP USAGE BETWEEN WEEK 1 AND WEEK 2	223
TABLE 6-4: PAPER-BASED TOOL USAGE BETWEEN WEEK 1 AND WEEK 2.....	223
TABLE 6-5: APP USAGE BETWEEN WEEK 2 AND WEEK 3	225
TABLE 6-6: PAPER-BASED TOOL USAGE BETWEEN WEEK 2 AND WEEK 3.....	226
TABLE 6-7: APP USAGE BETWEEN WEEK 3 AND WEEK 4	228
TABLE 6-8: PAPER-BASED TOOL USAGE BETWEEN WEEK 3 AND WEEK 4.....	228
TABLE 6-9: DE-BRIEFING EXPERIMENTAL GROUP	229
TABLE 6-10: DE-BRIEFING CONTROL GROUP.....	231
TABLE 6-11: POST-EXPERIMENT ASSESSMENT FOR EXPERIMENTAL GROUP.....	234
TABLE 6-12: POST-EXPERIMENT ASSESSMENT FOR CONTROL GROUP.....	234
TABLE 34-1: WEEK 3 RESULTS FOR QUESTION 1 FOR EXPERIMENTAL GROUP	476
TABLE 34-2: WEEK 3 RESULTS FOR QUESTION 1 FOR CONTROL GROUP	477
TABLE 34-3: WEEK 3 RESULTS FOR QUESTION 2 FOR EXPERIMENTAL GROUP	478
TABLE 34-4: WEEK 3 RESULTS FOR QUESTION 2 FOR CONTROL GROUP	479
TABLE 34-5: WEEK 3 RESULTS FOR QUESTION 3 FOR EXPERIMENTAL GROUP	480
TABLE 34-6: WEEK 3 RESULTS FOR QUESTION 3 FOR CONTROL GROUP	481
TABLE 34-7: WEEK 3 RESULTS FOR QUESTION 4 FOR EXPERIMENTAL GROUP	482
TABLE 34-8: WEEK 3 RESULTS FOR QUESTION 4 FOR CONTROL GROUP	482
TABLE 35-1: WEEK 4 RESULTS FOR QUESTION 1 FOR EXPERIMENTAL GROUP	484
TABLE 35-2: WEEK 4 RESULTS FOR QUESTION 1 FOR CONTROL GROUP	485
TABLE 35-3: WEEK 4 RESULTS FOR QUESTION 2 FOR EXPERIMENTAL GROUP	486
TABLE 35-4: WEEK 4 RESULTS FOR QUESTION 2 FOR CONTROL GROUP	487
TABLE 35-5: WEEK 4 RESULTS FOR QUESTION 3 FOR EXPERIMENTAL GROUP	488
TABLE 35-6: WEEK 4 RESULTS FOR QUESTION 3 FOR CONTROL GROUP	489
TABLE 35-7: WEEK 4 RESULTS FOR QUESTION 4 FOR EXPERIMENTAL GROUP	490
TABLE 35-8: WEEK 4 RESULTS FOR QUESTION 4 FOR CONTROL GROUP	491
TABLE 36-1: SUMMARY CODES WITH SEVERAL ITERATIONS	502
TABLE 36-2: PSEUDO-CODES AND MEANINGS USED IN THE CODING PROCESS.....	502
TABLE 36-3: OPEN CODES DEVELOPED FROM SUMMARY CODES	503
TABLE 36-4: AXIAL CODING WITH MULTIPLE ITERATIONS.....	504
TABLE 36-5: FINAL AXIAL CODES	505
TABLE 37-1: PURPOSE OF USING SMARTPHONES	511

IX. LIST OF FIGURES

FIGURE 1-1: THE RESEARCH DOMAIN.....	6
FIGURE 2-1: KNOWLEDGE-TO-ACTION FRAMEWORK	28
FIGURE 2-2: CONSUMER BEHAVIOUR FRAMEWORK.....	44
FIGURE 2-3: TRACEABILITY: AN INFORMATION SHARING PERSPECTIVE	68
FIGURE 3-1: MIXED METHODS RESEARCH APPROACH	90
FIGURE 3-2: RESEARCH DESIGN.....	111
FIGURE 3-3: RESEARCH TOOLS AND TECHNIQUES	112
FIGURE 4-1: PARTICIPANT LOCATION	133
FIGURE 4-2: PARTICIPANT HOUSEHOLD INCOME	134
FIGURE 4-3: SHOPPING TIME.....	135
FIGURE 4-4: MEAT TRANSPORTATION TIME	137
FIGURE 4-5: PRESERVATION MODE.....	140
FIGURE 4-6: PACKAGING FOR FRIDGE STORAGE.....	141
FIGURE 4-7: PACKAGING FOR FRIDGE STORAGE AND FRIDGE STORAGE SYSTEM	142
FIGURE 4-8: LENGTH OF TIME IN FRIDGE STORAGE.....	142
FIGURE 4-9: THAWING PROCEDURE	143
FIGURE 4-10: POST-THAW HANDLING 1	145
FIGURE 4-11: POST-THAW (TIME BEFORE COOKING).....	146
FIGURE 4-12: POST-THAW HANDLING 2	147
FIGURE 4-13: DONENESS ASSESSMENT	148
FIGURE 4-14: SAFE COOKING TEMPERATURES – MEDIUM RARE	149
FIGURE 4-15: SAFE COOKING TEMPERATURES – MEDIUM COOKED.....	149
FIGURE 4-16: SAFE COOKING TEMPERATURES – MEDIUM WELL.....	150
FIGURE 4-17: FRYING TIME - RARE	151
FIGURE 4-18: FRYING TIME – MEDIUM RARE.....	151
FIGURE 4-19: FRYING TIME – MEDIUM COOKED	152
FIGURE 4-20: FRYING TIME – MEDIUM WELL	153
FIGURE 4-21: FRYING TIME – WELL DONE.....	153
FIGURE 4-22: COOLING LEFTOVERS PRE-STORAGE	155
FIGURE 4-23: LEFTOVER STORAGE SYSTEM	156
FIGURE 4-24: PACKAGING FOR LEFTOVER STORAGE	157
FIGURE 4-25: LEFTOVER STORAGE TIME LENGTH	157
FIGURE 4-26: TIME TO CONSUME POST-REHEAT.....	158
FIGURE 4-27: GLOVE USER - SIMULTANEOUS COOKING MANAGEMENT.....	161
FIGURE 4-28: GLOVE MANAGEMENT.....	161
FIGURE 4-29: NON-GLOVE USER: SIMULTANEOUS COOKING MANAGEMENT	162
FIGURE 4-30: NON-GLOVE USER: HANDWASHING FREQUENCY	163
FIGURE 4-31: NON-GLOVE USER: HANDWASHING PROCESS.....	164

FIGURE 4-32: NON-GLOVE USER: HAND DRYING	165
FIGURE 5-1: SCENARIO 1 FOR TBA APP.....	182
FIGURE 5-2: SCENARIO 2 FOR PTA APP.....	183
FIGURE 5-3: SCENARIO 3 FOR INA APP.....	185
FIGURE 5-4: SCENARIO 1 - REMINDER FOR TBA APP.....	187
FIGURE 5-5: SCENARIO 2 - REMINDER FOR PTA APP.....	188
FIGURE 5-6: SCENARIO 3 - REMINDER FOR INA APP.....	189
FIGURE 5-7: ANDROID VERSION	208
FIGURE 5-8: IOS VERSION	208
FIGURE 5-9: QR CODE LINK TO THE ANDROID VERSION OF THE APP	208
FIGURE 5-10: QR CODE LINK TO THE IOS VERSION OF THE APP	209
FIGURE 6-1: PRE-EXISTING SAFE FOOD HANDLING KNOWLEDGE.....	221
FIGURE 6-2: POST-TEST 1: TO DEMONSTRATE 'REMEMBERING'	222
FIGURE 6-3: POST-TEST 2: TO DEMONSTRATE 'UNDERSTANDING'	225
FIGURE 6-4: TO 'APPLY' KNOWLEDGE.....	227
FIGURE 6-5: QUESTIONNAIRE-BASED POST-EXPERIMENT ASSESSMENT AFTER 6 WEEKS	233
FIGURE 6-6: PARTICIPANT ACJ'S KNOWLEDGE OPTIMISATION TRANSITION	235
FIGURE 6-7: PARTICIPANT ACC'S KNOWLEDGE OPTIMISATION TRANSITION.....	236
FIGURE 6-8: PARTICIPANT ACH'S KNOWLEDGE OPTIMISATION TRANSITION.....	237
FIGURE 6-9: PARTICIPANT ACM'S KNOWLEDGE OPTIMISATION TRANSITION	238
FIGURE 6-10: PARTICIPANT DCW'S KNOWLEDGE OPTIMISATION TRANSITION	239
FIGURE 6-11: PARTICIPANT DCT'S KNOWLEDGE OPTIMISATION TRANSITION	240
FIGURE 6-12: PARTICIPANT DCV'S KNOWLEDGE OPTIMISATION TRANSITION	241
FIGURE 6-13: PARTICIPANT DCH'S KNOWLEDGE OPTIMISATION TRANSITION	242
FIGURE 6-14: DEMONSTRATING REMEMBRANCE TO EMPHASISE KNOWLEDGE ACQUISITION BETWEEN WEEK 1 AND 2.....	243
FIGURE 6-15: DEMONSTRATING UNDERSTANDING BETWEEN WEEK 2 AND 3	245
FIGURE 6-16: DEMONSTRATING KNOWLEDGE APPLICATION BETWEEN WEEK 3 AND 4	247
FIGURE 6-17: TIME SPENT ON THE KNOWLEDGE ACQUISITION TOOL	248
FIGURE 6-18: NORMAL TRANSITION OF THE EXPERIMENTAL GROUP ACROSS THE KNOWLEDGE OPTIMISATION SPECTRUM.....	253
FIGURE 6-19: NORMAL TRANSITION OF THE CONTROL GROUP ACROSS THE KNOWLEDGE OPTIMISATION SPECTRUM.....	254
FIGURE 6-20: REVERSE TRANSITION OF THE CONTROL GROUP ACROSS THE KNOWLEDGE OPTIMISATION SPECTRUM.....	255
FIGURE 7-1: A MODIFIED USER CENTRED DESIGN APPROACH	276
FIGURE 33-1: HOME SCREEN.....	459
FIGURE 33-2: PREPARATION	460
FIGURE 33-3: IMPORTANT SAFE PREPARATION TIPS	461
FIGURE 33-4: GUIDE TO CORRECT COOKING TEMPERATURES.....	462

FIGURE 33-5: SPECIAL RULES FOR BARBECUES 1	463
FIGURE 33-6: SPECIAL RULES FOR BARBECUES 2	463
FIGURE 33-7: SPECIAL RULES FOR BARBECUES 3	464
FIGURE 33-8: SPECIFIC COOKING HELP	465
FIGURE 33-9: REHEATING LEFTOVERS	466
FIGURE 33-10: MICROWAVE COOKING 2	467
FIGURE 33-11: MICROWAVE COOKING 1	467
FIGURE 33-12: MICROWAVE COOKING 3	467
FIGURE 33-13: OTHER REHEATING TIPS	468
FIGURE 33-14: MEAT THERMOMETERS	469
FIGURE 33-15: TYPES OF THERMOMETERS	470
FIGURE 33-16: OVEN PROOF THERMOMETER	471
FIGURE 33-17: DIGITAL THERMOMETER	471
FIGURE 33-18: INSTANT READ THERMOMETER	471
FIGURE 33-19: POP UP THERMOMETER.....	471
FIGURE 33-20: SPECIAL MICROWAVE THERMOMETER.....	472
FIGURE 33-21: HOW TO USE THERMOMETERS	472
FIGURE 33-22: POULTRY.....	473
FIGURE 33-23: GROUND MEAT AND POULTRY.....	473
FIGURE 33-24: BEEF, PORK, LAMB, VEAL, HAM.....	474
FIGURE 33-25: CASSEROLES AND EGG DISHES	474
FIGURE 33-26: OTHER TIPS ON USING MEAT THERMOMETERS.....	475
FIGURE 36-1: RESEARCH ANALYSIS PROCESS	499
FIGURE 36-2: INTERVIEW TRANSCRIPT WITH SUMMARY CODE IDENTIFIED.....	501
FIGURE 36-3: FINAL THEME FOR PRELIMINARY STAGE, PHASE ONE	506
FIGURE 36-4: THEMES DEVELOPED FOR PRELIMINARY STAGE, PHASE ONE	507
FIGURE 36-5: FINAL GROUPING FOR A THEME IN PHASE TWO.....	507
FIGURE 36-6: THEMES DEVELOPED FOR PHASE TWO	507
FIGURE 37-1: DEMOGRAPHY - LEVEL OF EDUCATION.....	508
FIGURE 37-2: DEMOGRAPHY – AGE RANGE.....	509
FIGURE 37-3: SMARTPHONE USE – TIME LENGTH	510
FIGURE 37-4: SMARTPHONE USE – PARTICIPANT’S RATINGS	510
FIGURE 37-5: SMARTPHONE USE – AVERAGE DAILY USE.....	511
FIGURE 38-1: PARTICIPANT ACJ'S KNOWLEDGE OPTIMISATION TRANSITION	516
FIGURE 38-2: PARTICIPANT ACC'S KNOWLEDGE OPTIMISATION TRANSITION.....	518
FIGURE 38-3: PARTICIPANT ACH'S KNOWLEDGE OPTIMISATION TRANSITION.....	521
FIGURE 38-4: PARTICIPANT ACM'S KNOWLEDGE OPTIMISATION TRANSITION	523
FIGURE 38-5: PARTICIPANT DCW’S KNOWLEDGE OPTIMISATION TRANSITION	526
FIGURE 38-6: PARTICIPANT DCT’S KNOWLEDGE OPTIMISATION TRANSITION	529
FIGURE 38-7: PARTICIPANT DCV’S KNOWLEDGE OPTIMISATION TRANSITION	532

FIGURE 38-8: PARTICIPANT DCH’S KNOWLEDGE OPTIMISATION TRANSITION 534

FIGURE 39-1: AN EXAMPLE OF BEST-WORST QUESTION 542

CHAPTER ONE

INTRODUCTION

1 INTRODUCTION

This thesis investigates how the affordances of smartphone technology can be leveraged to enhance the provision of consumer food safety management information and facilitate knowledge retention amongst consumers to support safe food behaviours. This research integrates, within a mobile food safety application, insights from a heuristic framework, a consumer-based usability evaluation and best practice information on safe food management (**SFM**) from relevant government agencies in Australia. This research directly contributes to understanding of the influence of technology on consumers' knowledge acquisition, knowledge retention and perceptions of their capacity for behavioural change.

This chapter provides an introduction into the research and presents the research problem, research questions and associated objectives. It introduces the contributions the research makes to the body of knowledge within information systems (IS) discipline from the substantive, methodological and theoretical perspectives. The chapter is divided into the following sections;

- Section 1.1 presents the research domain within which this research is situated. The research is situated within the domains of information and communication technology (ICT), consumer behaviour and information and knowledge management (KM) all embedded within the context of food safety.
- Section 1.2 introduces the research problem, research aim, research questions and associated research objectives. Many consumers remain inadequately informed about food safety and continue to engage in unsafe food handling practices. Thus, there is need to investigate how best to share information to facilitate knowledge retention through the use of technology in an attempt to improve the food management behaviour of Australian consumers. This section also outlines the research approach.
- Section 1.3 presents a summary of the contributions the research makes to the body of knowledge within information systems (IS) discipline from the substantive, methodological and theoretical perspectives.
- Section 1.4 provides an overview of the thesis and outlines the remaining chapters.
- Section 1.5 provides a summary of the chapter.

1.1 Research Domain

Mitigating consumer health risks from food poisoning, caused by domestic mismanagement of food products from the point of purchase through to actual consumption, is now increasingly recognised as a growing source of concern in Australia (Bangboje-Ayodele et al., 2015). According to the New South Wales Food Authority, foods can become contaminated while in the possession of consumers in a number of ways including; not cooking food thoroughly, not storing food appropriately, poor hand hygiene, eating food after a ‘use-by’ date and cross contamination between foods (NSWFA, 2014). In Australia, out of the reported cases of food borne outbreaks in 2010, 2146 persons were affected, including 157 hospitalizations and 15 deaths (OzFoodNet, 2012). More recent figures reveal that there were 1828 reported outbreaks of enteric illnesses in 2014 out of which 30561 persons were affected, including 982 hospitalisations and 118 deaths (OzFoodNet, 2015). Apart from commercially prepared food, the consumer home has the highest percentage of food poisoning outbreaks in Australia (OzFoodNet, 2012) and raw meat was one of the major contributors to this as they sometimes contain harmful bacteria such as *Salmonella*, *Listeria*, *Campylobacter* and *E. coli* (NSWFA, 2015b).

In this context, and despite considerable efforts with regards to public food safety information campaigns, many consumers remain inadequately informed about food safety and continue to engage in unsafe food handling practices. Unsurprisingly, this has led to numerous research studies, in various disciplines, which are focused on addressing consumers’ food safety knowledge gaps (Bondarianzadeh et al., 2011, Ergönül, 2013, Losasso et al., 2012, Mateus et al., 2014, Nesbitt et al., 2014, Ovca and Jevšnik, 2009, Shim et al., 2011, Stenger et al., 2014, Taché and Carpentier, 2014). However, most of these studies (see section 2.1.4 for more details) have not been able to provide significant evidence to suggest that consumers indeed understand the information, can retain the knowledge acquired over time and can behave in a manner that corresponds to the acquired knowledge, in this case – safe food management.

While it has been argued that the amount and accuracy of consumers’ knowledge does not necessarily translate to corresponding behaviour (Al-Sakkaf, 2012, Aizaki et al., 2011), many research advocates have argued for the use of *theory-driven interventions* (social cognition theories such as the health belief model (Rimal, 2000), health action

process approach (Bearth et al., 2014a) and theory of planned behaviour (Sainsbury et al., 2013)) in designing health information systems. However, there is evidence to suggest that theory-driven interventions do not necessarily improve consumer behaviour. For example; to investigate the influence of a food hygiene intervention on human behaviour, Mullan and Wong (2010) and Phillip and Anita (2010) utilised the theory of planned behaviour to design an intervention. However, their findings indicate that the intervention did not improve the behaviour of the participants.

On the other hand, recent research into the use of *habit-driven interventions* have provided evidence to suggest that interventions that provide cues to actions and reminders that build food safety and management habits result in changes in behaviour. For example; Rompotis et al. (2014) successfully used habit formation to improve fruit and vegetable consumption behaviour through the use of SMS and email as information delivery channels. Also, Mullan et al. (2014) successfully used habit strength to improve food safety behaviour through the use of poster and email as information delivery channels. However, the participant group for their study was limited to undergraduate students in a university. Therefore, one can argue that a more thorough understanding may be gained if the sample covers a broader population. Nonetheless, it appears habit-driven interventions are more promising in facilitating an improvement in safe food handling practices.

Drawing on these habit-driven studies, one common theme is the use of information and communication technology (ICT) which includes smartphone apps due to their ability to provide information through diverse modalities (textual, visual, verbal and integrated) which may help to provide cues to action and reminders. However, with reference to the examples cited above, Mullan et al. (2014) did not investigate the influence or differences between the use of textual and visual information cues (poster) and text-based cues only (email). For Rompotis et al. (2014), they found that there were no differences between SMS (text-based) and email (text-based) delivery channels. However, it remains unclear how textual, visual, and integrated information modalities and other information delivery tools such as smartphone apps would influence consumer safe food handling practices (post-purchase) as studies in the Information Systems discipline suggest that textual (Blanco et al., 2010), visual (Ha and Lennon, 2010, Lin et al., 2012) and verbal (Kim and Lennon, 2008) modes of information influence consumer

pre-purchase behaviour in relation to commodities that are not related to food. These findings are also in line with the principle of modality effect (Mayer, 2014) drawn from the cognitive theory of multimedia learning which has only been utilised from the perspective of pedagogical frameworks. However, pedagogical frameworks are only tangentially relevant to the context of this study, unlike frameworks about adult learners (more commonly referred to as andragogy - (Knowles, 1970)) that are more relevant to adult consumers who are domestic food handlers. Andragogy (the adult learning principle) is the art and science of teaching adults based on the six assumptions of self-directedness, need to know, use of experience in learning, readiness to learn, orientation to learning, and internal motivation (Knowles et al., 2014). It is a framework that is appropriate for this study as the domestic food handlers and consumers fit the characteristics of adult learners as defined by De Vito (2010). These characteristics are as follows;

- They are typically aged 24 years or older
- They are not financially dependent on parents or guardians
- Their main responsibilities are outside schooling
- Their principal identities have evolved beyond the role of full-time student.

As such the findings on information modalities should be investigated within this research context. Thus, efforts made to investigate the influence of information modalities and the affordances of smartphone apps as a potential knowledge acquisition tool in an attempt to improve consumer safe food management behaviour, will bridge the gap in the body of knowledge on information and communication technologies (ICT), consumer behaviour, and information & knowledge management (KM).

Therefore, this research is situated within the domains of information and communication technologies (ICTs), consumer behaviour and information & knowledge management (KM), all embedded within the context of food safety. Figure 1-1 illustrates the three research domains.

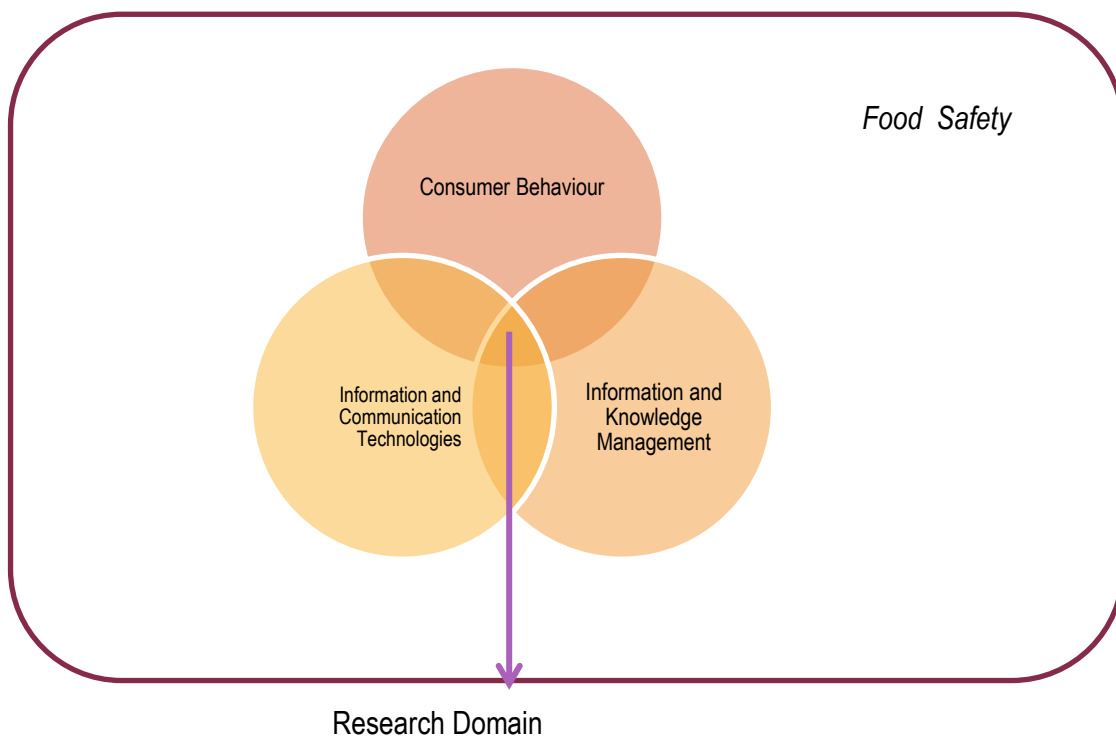


Figure 1-1: The Research Domain

1.2 Research Problem

Alleviating food safety risks is a major source of concern for government authorities, the food industry and other stakeholders. Diverse innovative mechanisms focused on monitoring and controlling production processes across supply chains, such as ISO22000 (Varzakas and Arvanitoyannis, 2008), HACCP control systems (Unnevehr and Jensen, 1999), HARPC control systems (Grover et al., 2016), traceability systems (Regattieri et al., 2007), have been employed to address many of these risks. However, most of these food safety mechanisms are largely focused on supply chain activities from ‘*paddock-to-purchase*’ (pre-purchase) as the legal obligations of supply chain partners on food safety tends to be completed once consumers purchase the products (Bamgboje-Ayodele et al., 2016). Thus, *mitigating food safety risks during the process of consumption (post-purchase), which entails domestic food management and handling from the point of purchase (purchase) to the point of actual consumption (plate), is largely the responsibility of consumers.*

Whilst the unsettling level of food poisoning outbreaks through domestic food mismanagement from ‘*purchase-to-plate*’ is not a new phenomenon, the complexity and dynamism of the characteristics of consumers has made it continually difficult to address. For example; the varying degree of food safety knowledge has facilitated many

public food safety information campaigns, education and awareness programs (Harper and Henson, 2001, Dharod et al., 2004, Verbeke et al., 2007). Despite these efforts, many consumers remain inadequately informed about food safety and continue to engage in unsafe food handling practices.

Whilst there are a range of approaches within information and communication technologies (ICTs), consumer behaviour, knowledge management and food safety management disciplines that can be used to address these challenges, it is clear that the use of ICTs in the context of information campaigns need to be enhanced to better share information to facilitate knowledge retention to contribute to the improvement of the food management behaviour of Australian consumers.

With the recent advancement in ICT, smartphones have become the mainstream in mobile phones (Duan et al., 2014), as it provides users with the ability to engage with their phones like a traditional personal computer that is connected to the internet and other data networks with the advantage of portability and mobility (Luxton et al., 2011). This results in a highly personalised nature of smartphones as they embody a user-empowering characteristic (Tossell et al., 2012), thus providing users with an array of capabilities and experiences that are tailored to their interests. One way to demonstrate such level of personalization is the ability to allow users to download diverse mobile applications or ‘apps’ onto their smartphones (Jung, 2014) which affords consumers the opportunity to inform themselves about specific areas of interests (Verkasalo et al., 2010) such as safe food handling practices. This personalised nature has given consumers the opportunity to download apps that can inform them about food in terms of tasks such as personalized grocery shopping apps (Clear et al., 2015), food cooking apps (Bähler, 2015) and food storage or wastage apps (Farr-Wharton et al., 2014). However, for the apps that are focused on domestic food handling practices for Australian consumers, three issues have been identified in relation to their context of use, user experience and best practice guidelines on health information systems.

First, in terms of the context of use, there is evidence that the existing apps provide information in silos in relation to the various aspects (safe shopping of perishable food items, safe transportation of perishable food items, safe storage of perishable food items, safe preparation of food items and appropriate kitchen hygiene practices) of domestic SFM for Australian consumers (Henley et al., 2012), thus resulting in lack of continuity

from one food handling stage to the other. In addition, existing apps that are focused on food cooking tend not to emphasise the safety of the process; rather, the focus is usually on the recipe. Also, existing apps provide very limited information to address safe transportation from the point of purchase to the consumer's home and subsequent kitchen hygiene practices.

Therefore, *there is need for a smartphone app that seamlessly integrates all the different stages of safe food handling while addressing each stage with a focus on safety for Australian consumers.*

Second, in terms of the user experience, there is insufficient evidence that existing apps have drawn upon information modality studies which bridges the gap between communication technologies and consumer behaviour. This has led to many studies within the human computing interaction (HCI) and consumer behaviour disciplines as government authorities and businesses have continuously tried to change consumer attitudes by employing different communication models in order to achieve their intended purpose. The traditional communication model (Solomon et al., 2009) which focuses on the source, the media and the message highlights the importance of the characteristics of the message as it has the potential to influence consumer attitudes because the “*what*” of the message and “*how*” the message is conveyed are powerful variables (Solomon et al., 2009). This has led to numerous IS debates about the impact of textual (Blanco et al., 2010), visual (Ha and Lennon, 2010), verbal (Kim and Lennon, 2008) or integrated information modalities on consumer responses to such information. However, the challenge here is that *these information modality studies have focused on influencing consumer behaviour before the purchase of a certain product which may not be applicable to the post-purchase context portrayed in this study.*

Aligned to these studies is the principle of modality effect (Brunken et al., 2003), drawn from the cognitive theory of multimedia learning, which argues that materials presented in a format that simultaneously uses the auditory and the visual sensory modality is better than by a format that uses only the visual modality when aiming to optimise consumer knowledge (Mayer and Chandler, 2001). Thus, arguing that there is tendency for a smartphone app which incorporates textual, visual and integrated information modalities to better deliver information to its user. However, the problem with this argument is that available evidence suggests the use of this principle only within

pedagogical frameworks (Harskamp et al., 2007) which may not necessarily be applicable to domestic food handlers who tend to be adult consumers. Optimising the knowledge of adult consumers tend to lean towards the use of frameworks on adult learners as such people have the following characteristics (De Vito, 2010);

- They are typically aged 24 years or older
- They are not financially dependent on parents or guardians
- Their main responsibilities are outside schooling
- Their principal identities have evolved beyond the role of full-time student.

As such, it is unclear if the principle of modality effect can indeed be applicable to the context of optimising the knowledge of adult consumers on safe food management as its applicability can be leveraged to improve user experience during the use of SFM apps. *Thus, there is need to conduct consumer-based usability evaluations on existing food apps with different information modalities to provide insights into how they influence consumer responses post-purchase.*

Third, there is insufficient evidence to suggest that existing apps have been comprehensively evaluated (Oliveira et al., 2013) and that they were developed based on frameworks guiding mobile health consumer apps, thus questioning whether best practice guidelines were adhered to. More specifically, there is a dearth of research that assesses how well the content of the app has been designed for consumers with considerations for both usability and health literacy. The few evaluations that have been conducted have been restricted usability assessments such that questions about the importance of contexts of use and the attributes and behaviours of end-users have been marginalised. To address this concern, Monkman and Kushniruk (2013) adapted a set of existing guidelines for the design of consumer health Web sites (DHHS, 2010, DHHS, 2007) into evidence-based evaluation heuristics tailored specifically for mobile consumer health applications. Whilst they have tested the heuristics by evaluating a single mobile consumer health app from an expert's perspective, such assessment is not sufficient to address issues about the contexts of use and the attributes and behaviours of end-users without consulting the consumers. This is based on the argument provided by Tullis and Wood (2004) who believe that findings based on the smallest sample sizes provide more useful insights than speculations by a designer or an expert who is not a

potential user of the app for which it is being developed. Therefore, it is imperative to address these issues by adopting a health literacy online heuristics (HLOH) framework and combining it with a consumer-based evaluation to holistically assess the usability of consumer health applications, their contexts of use and attributes of the end-users. *Thus, there is need to incorporate a validated health literacy online heuristic (HLOH) framework in the design of a SFM app.*

Therefore, based on the aforementioned reasons, it is imperative: to gain insights from relevant government authorities about information that encompasses all the various aspects of domestic SFM for Australian consumers; to conduct consumer-based usability evaluations on existing food apps with different information modalities to provide insights into how they influence consumer responses post-purchase; and to incorporate a validated health literacy online heuristic (HLOH) framework in the design of a SFM app. All of these lead to the design and development of a SFM app which will be implemented and evaluated to determine if knowledge acquisition occurs, if the knowledge has been retained, if the knowledge can be applied and if there are perceived behavioural changes. These insights can be used to develop nation-wide interventions for addressing consumer knowledge gaps in safe food management in the home. This led to the following research aim.

1.2.1 Research Aim

This thesis investigates how the affordances of smartphone technology can be leveraged to enhance the provision of information and facilitate knowledge retention. Thus, this study aimed to provide insights into how best to share information to facilitate knowledge retention through the use of technology in an attempt to improve the food management behaviour of Australian consumers. This resulted in the following overarching research question: How can the affordances of smartphone technology be leveraged to enhance consumers' safe food management?

1.2.2 Research Questions and Objectives

Research Question1: To what extent do gaps exist in consumers' food safety knowledge?

Research Question 1, Objective 1: To determine the role played by a food firm in updating consumers' food safety knowledge during a recall incident.

Research Question 1, Objective 2: To identify safe food management knowledge gaps in consumers.

Research Question 2: How can technology support the delivery of food safety information to consumers in a manner that facilitates better understanding?

Research Question 2, Objective 1: To identify whether and how safe food management app designs differ from generic app design principles.

Research Question 2, Objective 2: To design and develop a safe food management smartphone app.

Research Question 3: How does the use of a safe food management app influence consumer knowledge acquisition, knowledge retention and perceived behavioural change?

Research Question 3, Objective 1: To determine the impact of the app on consumer knowledge acquisition and knowledge retention.

Research Question 3, Objective 2: To determine the impact of the app on perceived behavioural change.

1.2.3 Research Approach

The research consisted of three phases: In Phase one, the preliminary stage explored the boundaries of domestic food safety by investigating the communication of a food firm that had recently experienced a recall situation, through a case study approach, using

semi-structured interviews, field notes and document reviews. The final stage for phase one explored the food handling practices of consumers to identify inappropriate (*target*) food handling practice by surveying 217 participants living in Australia drawn from the database of an ISO certified consumer panel.

Phase two involved the conduct of a heuristic evaluation of three (text-based app, audio-visual app and integrated app) currently available SFM apps that address the target food handling practice, based on Monkman and Kushniruk (2013) health literacy online heuristics (HLOH) framework. The framework was chosen as it depicts an intrinsic relationship between usability and health literacy while advocating for consumer health information systems to be designed with considerations for usability and for consumers that have limited health literacy. Thus, in this study, the term “health literacy” is used as a proxy for the end user’s skills and attributes in relation to their understanding of the information content within the food safety context. Following this, it explored the user experience with the three apps through a consumer level evaluation, based on quantitative and qualitative information tasks conducted in a focus group session. Lessons learnt from both evaluations were incorporated into the design and development of the SFM app.

Phase three involved the implementation of the SFM app and the evaluation of the impact of the app. In this phase, baseline data was collected on the participants’ level of knowledge; they were involved in a 4-week field experiment using scenarios where they used the app and where they did not use the app. During this time, data was collected using open and closed questionnaires. Six-weeks after the experiment the participants were questioned to investigate their perceived knowledge retention and behavioural changes. There is precedence for the use of six-weeks as it has been previously deemed sufficient in the literature (Biran et al., 2014) for safe food handling behavioural change (see section 3.3.3.4 for details).

The data collected through the three phases were analysed and interpreted independently within each phase before progressing to the next phase, due to the sequential nature of the phases of the research design. Data collected for the preliminary stage of phase one was analysed with an inductive thematic approach to develop abstracted themes that were interpreted to gain insights that led to the focus on consumer safe food management post-purchase. Data collected for the final stage of phase one was analysed

using descriptive statistics which helped to identify the inappropriate (*target*) food handling practices of the participants. Data collected for phase two was analysed manually except the card sorting technique which was analysed with an inductive thematic approach that developed abstracted themes. Data collected for phase three was analysed manually for the open-ended questionnaires and through the use of descriptive statistics for the closed ended questionnaires. Further interpretation of the research findings answered the research questions and objectives based on the researcher's understanding of the data and in relation to the available literature to generate the key findings of the research.

1.3 Summary of Contributions

This research has made a number of contributions at substantive, methodological and theoretical levels.

At the substantive level, this research has contributed significantly by providing insights in three areas: sources of food safety knowledge gaps in consumers during food incidents; food safety knowledge gap areas requiring public health interventions and how the affordances of smartphones can be leveraged to enhance consumer SFM knowledge in an attempt to improve the food management behaviour of Australian consumers.

First, this research has illustrated the use of a case study approach, based on a recall incident in a food firm, to identify sources of consumer food safety knowledge gaps and apply the insight obtained into a consumer empowerment strategy. This has generated insights into the communication gaps that exist between a firm and its consumers during a food recall incident. Also, it identified factors facilitating a firm's recovery from a recall incident. These insights are particularly deemed important and rare due to the difficulty experienced when attempting to conduct a case study investigation with a food firm that had just experienced a recall, as it is difficult for firms to accommodate researchers during such a sensitive situation.

Second, this research has identified food safety knowledge gap areas not only during a food incident but more broadly during normal day to day activities. These knowledge gap areas have provided a focus for government authorities to concentrate their efforts on public health interventions that aim to address the identified problems. Thus, this

research has informed government authorities and has made substantive contributions to public health issues requiring interventions.

Third, the research also discovered in-depth insights into how the affordances of smartphones can be leveraged to enhance consumer SFM knowledge in an attempt to improve the food management behaviour of Australian consumers. These insights have provided a clear picture of how to enhance the use of ICTs in the context of information campaigns for better sharing of information to facilitate knowledge retention to contribute to the improvement of the food management behaviour of Australian consumers.

At the methodological level, the research was designed in such a way that the subject area was first explored in phase one, to refine the research area. In addition, the research tested an existing usability framework in phase two and conducted practical field evaluation in phase three. Furthermore, the research employed a non-conventional software methodology by utilising a modified user centred design (UCD) approach using a heuristic framework combined with consumer evaluation outputs, as a basis for app development.

At the theoretical level, this research has provided insights into additional principles that should be combined with Monkman and Kushniruk's (2013) HLOH framework when designing a SFM app; thus providing design insights for Information Systems researchers that aim to develop apps that provide information on SFM.

1.4 Overview of the Thesis

This section provides an overview of the remaining chapters of this thesis.

1.4.1 Chapter 2 - Literature Review

Chapter 2 provides a review of the literature in the research context of food safety and the core areas of information and communication technologies (ICTs) consumer behaviour and information management and knowledge management concepts. The review is supported by a critical review of the literature. The chapter commences by providing a background to the research context – in this case – food safety. Food safety is discussed using an Information Technology (IT) lens while explaining regulatory

solutions to food safety issues and safe food management from a consumer perspective. Information and communication technologies (ICTs) is reviewed in terms of mobile computing which includes smartphone apps and usability, context of use & attributes of end-users in safe food management. Consumer behaviour is introduced and discussed in relation to communication from an information modality perspective, consumer and food information processing peculiarities, consumer food behaviour and risk communication and ICTs. The chapter concludes with a review of information management and knowledge management concepts by focusing on knowledge acquisition, knowledge retention and knowledge application.

1.4.2 Chapter 3 – Methodology

Chapter 3 describes the research methods utilised within this research. The chapter presents the philosophical stance adopted, the research strategy, the research design as well as the tools and techniques used to conduct the research. It also presents the method of data analysis and the interpretation process used in the research. This led to the conclusion of the chapter.

1.4.3 Chapter 4 – Data Analysis and Preliminary Findings: Investigating Knowledge Gaps

Chapter 4 describes the data analysis and preliminary findings of both stages in phase one. First, Phase one, Stage one – Firm Perspective of the research: The focus of this stage was to determine the role played by a food firm in updating consumers' food safety knowledge during a food recall incident. The data analysis was conducted using inductive thematic analysis. The data was collected using semi-structured interviews as the primary data source as well as document reviews and field notes as a secondary data source. The themes produced as a result of the inductive coding process are discussed and interpreted while relating it back to the Phase one of the research. This section concludes with a summary of the preliminary findings from the firm perspective.

Second, Phase one, Stage two - Consumer Perspective of the research: This covers the analysis and discussions of the collected data, through an online survey. The dataset was analysed using two different approaches. The survey data was statistically analysed in order to create a range of descriptive statistical diagrams and tables for the post-purchase questions. The survey data was also used to generate tables to represent the best-worst scaling attributes selected by the participants for the pre-purchase questions and the IT

related questions. This section concludes with a summary of the preliminary findings from the consumer perspective.

The chapter concludes with a summary of the initial findings on food safety knowledge gaps.

1.4.4 Chapter 5 – Data Analysis and Preliminary Findings: Design and Development of the Safe Food Management App

Chapter 5 discusses the data analysis and preliminary findings of the phase that focuses on the design and development of the safe food management app. For the design of the smartphone app, the aim of this phase was to learn from existing apps and understand whether there are differences in how safe food management apps should be designed when compared to generic app design principles. This led to the adoption of the health literacy online heuristics framework while combining it with a consumer-based evaluation to holistically assess the usability of these applications, their contexts of use and attributes of the end-users. The data collection techniques for the first usability evaluation included information tasks developed by the researcher based on Monkman and Kushniruk (2013) framework. The data collection techniques for the second usability evaluation involved a scenario based focus group session using quantitative and qualitative information tasks, card sorting technique and a questionnaire. A focus group session was the primary mode of data collection.

The chapter progresses by discussing the issues of the existing apps which are negative features that must be avoided in this app design. Furthermore, it discussed the benefits or positive features of the existing apps that will be translated into the development of the safe food management (SFM) app. Following this, it produced the prototype of the app design. Thus, the findings provided rich insights that were incorporated into the design and development of the SFM app. This led to the development of the smartphone application for educating and assisting consumers on the safe food management knowledge gaps identified from the survey in Phase 1.

1.4.5 Chapter 6 – Data Analysis and Preliminary Findings: Implementing and Evaluating the Safe Food Management App

Chapter 6 presents the data analysis and preliminary findings of the phase that focuses on implementing and evaluating the safe food management app. The focus of this phase

involved the use of a field experiment to investigate the impact of the safe food management app on consumers' knowledge acquisition, knowledge retention and perceived behavioural change. This covers the analysis of the collected data, through face-to-face closed-ended and open-ended questionnaires on safe food handling knowledge from consumers across a period of 4 weeks. The dataset was analysed using two different approaches. The closed-ended questionnaire was statistically analysed in order to create a range of descriptive statistical diagrams and tables while the open-ended questionnaires were manually analysed. The chapter discusses the impact of the activities that occurred in each week of the experiment. It progresses by providing a picture of how the experiment influenced each participant during and after the experiment. Furthermore, it integrates and discusses the findings of the experiment across the 4 week period. Following this, it discusses the level and the impact of the usage of the safe food management app over the period of the experiment before providing the initial findings emanating from the experiment which led to the conclusion of the chapter.

1.4.6 Chapter 7 – Answering the Research Questions – Key Findings

Chapter 7 presents the five key findings that emerged from discussing and interpreting the data in sections 5 and 6. These findings are further discussed in relation to the available literature and in relation to the research questions and research objectives stated in section 1.

1.4.7 Chapter 8 – Conclusion

Chapter 8 presents a summary of the research findings generated from this thesis and it discusses the contributions to knowledge this research has made. Following this, the chapter discusses the limitations of the research and provides suggestions for future research.

1.5 Chapter Summary

This chapter has provided an introduction to this research. The research problem, research aim, research questions and associated research objectives have been discussed. The research questions and objectives aimed to investigate how the affordances of smartphone technology can be leveraged to enhance the provision of information and facilitate knowledge retention. To achieve this, this research draws upon the use of technology by incorporating a heuristic framework, a consumer-based usability

evaluation and best practice information on safe food management (SFM) from relevant government agencies in Australia. This led to the evaluation of the influence of technology on consumers' knowledge acquisition, knowledge retention and perceived behavioural change. Thus, this study aimed at sharing information to facilitate knowledge retention through the use of technology in an attempt to improve the food management behaviour of Australian consumers.

The contributions the research makes to the body of knowledge within information systems (IS) discipline has been discussed from the substantive, methodological and theoretical perspectives. The next chapter presents a review of the literature related to this study.

CHAPTER TWO

LITERATURE REVIEW

2 LITERATURE REVIEW

This non-systematic review was led by the research questions due to the exploratory nature of this study. The journey of the review process began with an investigation into the food safety domain in an attempt to identify gaps around the use of information and communication technologies. The identified gaps led to the focus on consumers behaviour in relation to food handling rather than food firms. With this focus on consumers, there was a need to investigate how consumer knowledge can be optimised (knowledge management) to improve their food safety behaviour. Therefore, this review is divided into four parts which comprises the major aspects of the proposed research. The four parts are concerned with food safety as the research context, information and communication technologies, consumer behaviour and an introduction to knowledge management. Thus, this chapter is divided into the following sections;

- Section 2.1 presents the body of literature that has been reviewed concerning the research context in terms of food safety using an Information Technology (IT) lens. This entails food chains, regulatory solutions to food safety issues and safe food management from a consumer perspective.
- Section 2.2 discusses the information and communication technologies (ICTs) in terms of the pervasiveness of ICT and mobile computing which includes smartphone use and food management as well as smartphone apps and usability, context of use and attributes of end-users in safe food management.
- Section 2.3 discusses consumer behaviour in relation to the context of this research. This is comprised of an introduction to consumer behaviour, communication from an information modality perspective, consumer and food information processing peculiarities, consumer food behaviour and risk communication & ICT.
- Section 2.4 discusses an introduction to data, information and knowledge and progresses by discussing information management and knowledge management (KM) concepts. Following this, it discusses knowledge optimisation as KM, based on an individual unit of analysis, by focusing on knowledge acquisition, knowledge retention and knowledge application.
- Section 2.5 provides a summary of the chapter.

2.1 An Introduction to Knowledge Management (KM)

This presents an overview of the literature relating to knowledge management with reference to the research context. It starts by providing an introduction to information management and knowledge management concepts. Following this, it discusses knowledge optimisation as KM based on an individual unit of analysis, by focusing on knowledge acquisition, knowledge retention and knowledge application. It then concludes with a critical reflection.

2.1.1 Information Management and Knowledge Management

2.1.1.1 Information Management

Davenport and Prusak (2000), Oppenheim et al. (2003) regard information as a message. For Davenport and Prusak (2000), information is a “message which is usually in the form of a document or an audible or visible communication” while Oppenheim et al. (2003) believe that “information that is communicated has both the intention of the sender and the expectations of the receiver to take into account”. Meadow et al. (1999), Wiig (1999), Mitchell (2000) define information with reference to data. For Meadow et al. (1999), “information has no universally accepted meaning but generally carries the connotation of evaluated, validated or useful data” while Wiig (1999) believes that information can be regarded as “facts and data organised to characterize a particular situation” but more simply, information can be defined as data made meaningful by putting it into context (Mitchell, 2000).

Information is a vague and elusive concept capable of being understood in various ways (Gourlay, 2000). Information, which some regard as explicit knowledge, can also be conceived as knowledge that can be codified and therefore more easily communicated and shared (Bouthillier and Shearer, 2002). Knowledge management (KM) writers view explicit knowledge as structured and conscious, hence it can be stored in information technology systems (Mårtensson, 2000).

Information management (IM) focuses on the “plans and activities that need to be performed to control an organisation’s records” (Place and Hyslop, 1982). However, Cronin (1985) believes that the focus of IM initiatives is often to control systematically recorded information and less on the use of these records (Bouthillier and Shearer,

2002). For Wilson (1989), IM is the management of information resources of an organisation and it involves the management of information technology.

Having defined the basic goal of IM as the “harnessing of information resources and information capabilities of an organisation in order to enable the organisation to learn and adapt to its changing environment”, Choo (2002) proposed a process model of IM which was presented as a cycle with five basic steps. These are: identification of information needs, information acquisition, information organisation and storage, information distribution and information use. Planning, organisation, coordination and control of a number of activities are all required for each of the aforementioned steps in Choo’s model. According to him, IM is key for sustaining knowledge creation and application in organisations and should lead to an ‘intelligent organisation’.

2.1.1.2 Knowledge Management

Knowledge is fluid, fuzzy, multi-faceted and multi-contextual in nature. Philosophers, scholars and practitioners have attempted to define knowledge in different ways, contexts and disciplines. One of these, is the definition offered by Prussak and Davenport (1998), that “knowledge is an interplay of fluid experiences, values, contextual information and intuition that provides a structure to evaluate and incorporate new experiences and information”. Within the Information Systems discipline; based on what the literature provides; it is clear that scholars and researchers have perceived knowledge from three different stand-points.

The first standpoint presents *knowledge as a duality*. This means that all knowledge is both explicit and tacit but the explicitness or tacitness is in varying proportions (Hildreth and Kimble, 2002). The more tacit aspects of knowledge are those that cannot be externalized while the more explicit ones can be articulated, captured and stored. However, this concept views both perspectives as interwoven and that they are not mutually exclusive of each other. In line with this, Cook and Brown (1999) argue that knowledge relies on both sides of the coin. Hildreth and Kimble (2002) argue that this standpoint helps to explain the reason why some of the knowledge management initiatives have failed. This is due to the fact that when explicit knowledge is abstracted in isolation, the representation is incomplete. Hence, tacit knowledge must also be incorporated.

The second standpoint presents *knowledge as a continuum*. This means that on one end of a spectrum, explicit knowledge (codified, structured and accessible to other people) exists, tacit knowledge (semi-conscious and unconscious, residing in humans) exists on the other end while varying proportions of both types of knowledge exist in between the two extremes (Leonard and Sensiper, 1998); (Jasimuddin et al., 2005). In accordance with this, Hall and Andriani (2003); Boland et al. (1994) treat explicit and tacit knowledge as the extremes of the spectrum. This standpoint views knowledge as three different types; explicit knowledge, the mixture of both explicit and tacit knowledge and tacit knowledge, as opposed to the two types of knowledge identified within the first standpoint.

While the third standpoint, presents *knowledge as a category*; which is either explicit or tacit. According to Nonaka (1994), explicit knowledge is easy to articulate, can be codified, stored and transferred easily. Polanyi (1967) and Goguen (1997) believe tacit knowledge cannot be articulated whereas Nonaka (1994) and Teece (1998) argue that knowledge can be articulated, though not easily, while Huang (1997) believes that it cannot only be articulated, it can also be captured. It is worthy of note here that, when it is stated that knowledge can be captured, it is perceived that knowledge is seen as an object. When knowledge is perceived as an object, Kimble et al. (2001) and Shum (1998) argue that the supposed knowledge management is actually information resource management because the presumed knowledge has become information. Hence, within the third stand-point, there are diverse contentions and contradictions as to what explicit and tacit knowledge is and what it should be.

Moving forward, Dogan et al. (2011) recently analysed the definitions of Jashapara (2004), Prussak and Davenport (1998), Wiig (1997), Drucker (2007) using logical models. Eventually, in consonance with Jashapara's definition, they believe that "*KM is the management of knowledge as a human-centred attribute that involves a learning and transformation process considering the environmental and cultural aspects to provide competitive advantage*".

Viewing the concept of KM with the same lens as Dogan et al. (2011) portrays knowledge as contextual information which resides in human minds. Hence, it can involve a learning and transformation process while considering the environmental and cultural aspects to provide competitive advantage. However, the use of the term

“Knowledge Management” appears inappropriate since the main goal is to optimise the knowledge contained within the people in or outside an organisation (as defined by the context) through sharing and learning while considering the environmental and cultural aspects in order to provide competitive advantage. Moreover, when the unit of analysis shifts from the organisational level to the individual level, it becomes clearer that an individual’s knowledge should not be managed but optimised. In this research context, which focuses on improving consumer knowledge and possibly their behaviour on safe food management, it is therefore reasonable to adopt the term “Knowledge Optimisation” rather than “Knowledge Management”.

2.1.2 Knowledge Optimisation

To optimise consumer knowledge, considering KM based on an individual unit of analysis, involves ensuring that knowledge acquisition occurs, the knowledge has been retained and the knowledge can be applied. This leads to a discussion on Knowledge Acquisition, Knowledge Retention and Knowledge Application.

2.1.2.1 Knowledge Acquisition

As described by He et al. (2013), knowledge acquisition is concerned with accessing and absorbing knowledge through direct or indirect contact or interaction with knowledge sources. As earlier discussed, knowledge has largely been viewed from two schools of thought, with one category viewing it as what can be codified and stored (explicit) and the other category viewing it as what resides in individuals (tacit). In this research, which is based on optimising consumer knowledge to ensure safe food management practices, the latter school of thought is drawn upon, due to the focus on individuals. Therefore, knowledge acquisition in this study is described as knowledge inflow (Mom et al., 2007) where the recipient – the consumer – acquires safe food management knowledge from the donor – government authorities, best practice guidelines, research studies.

Within this school of thought, knowledge acquisition has largely been explored from the perspective of facilitating student learning through pedagogical frameworks (Yelland et al., 2008) but more specifically technological pedagogical frameworks (Beetham and Sharpe, 2013). This has led to diverse studies in electronic learning (e-learning), mobile

learning (m-learning) and ubiquitous learning (u-learning) (Park, 2011). According to Peters (2007), e-Learning is a web-based delivery of content and learning management while m-learning refers to mediated learning through mobile technologies (Winters, 2007) or wireless interactive learning devices (Pea and Maldonado, 2006). Also, Park (2011) defined u-learning as a learning environment where students can easily access diverse digital devices and services whenever and wherever they are needed. In line with these studies, one set of approaches for enhancing the learning outcomes of educational programs recommends presenting multimedia learning resources to the learners by drawing upon the cognitive theory of multimedia learning (Mayer, 2009). These approaches based on using multimedia learning resources have been proven useful and successful in middle school students (McTigue, 2009), high school students (Schrader and Rapp, 2016) and undergraduates (Ljubojevic et al., 2014) thus drawing upon pedagogical frameworks but not in informal intervention programs aimed at improving domestic safe food handling behaviour of adult learners who are not necessarily enrolled in any institution of learning. However, there is scarce research on knowledge acquisition from the perspective of adult consumers through adult learning frameworks as such people have the following characteristics (De Vito, 2010);

- They are typically aged 24 years or older
- They are not financially dependent on parents or guardians
- Their main responsibilities are outside schooling
- Their principal identities have evolved beyond the role of full-time student.

Nonetheless, when the cognitive theory of multimedia learning is integrated with Bloom's taxonomy (Anderson et al., 2001), which structures knowledge acquisition around remembering, understanding, applying, analysing, synthesizing and evaluating as levels of complexity, it creates a dependent and cumulative hierarchy of cognitive competences (dos Santos Nunes et al., 2016). This is due to the fact that it relates knowledge acquisition with the learner's behavioural change, which is one of the anticipated goals of this research. Nonetheless, due to the research context defined for this study, consumers only need to be able to remember, understand and apply knowledge acquired for day-to-day food handling and management practices. Thus, it can be argued that only some of Bloom's levels of knowledge acquisition are relevant to this research.

Within this context a study by Levett-Jones et al. (2011) used validated multiple choice questions to measure knowledge acquisition levels in nursing students with ages ranging from 20 to 54, which can be classified as adult learners. Their findings revealed that only lower order cognitive processing such as the first level of Bloom's taxonomy (remembering) could occur. Thus, the findings reveal that when targeting the lower-order cognitive process of remembering, multiple choice questions are useful as they do not have the capacity to demonstrate beyond the process of "remembering" towards higher order skills (Levett-Jones et al., 2011).

Therefore, whilst this research acknowledges the importance of digital pedagogical frameworks in relation to knowledge acquisition and the relevance of a few of its concepts to this research, it however argues that this research is not submerged within the digital educational research space as it is only tangentially relevant to the context defined for this study. Nonetheless, it appears lessons can be learnt from adult learning frameworks as they appear more relevant than pedagogical frameworks.

2.1.2.2 Knowledge Retention

Drawing upon the school of thought highlighted in the preceding sub-section (knowledge resides in people's minds), this research is in consonance with the definition of knowledge retention provided by Caroline Martins and Meyer (2012). They defined knowledge retention as the 'maintenance of knowledge' that exists in the minds of people and the 'maintenance of knowing' that is referred to as experiential action manifesting in behaviour. Also, it has been argued that the manifestation of knowledge through certain behaviour during cognitive and knowledge acquisition processes could enhance knowledge retention (Martins and Martins, 2011).

Within the knowledge management discipline, diverse studies on knowledge retention have been conducted in various industries and organisations. These include; retention of tacit knowledge in small manufacturing businesses (Wong and Radcliffe, 2000), the effect of knowledge loss on utility workforce (Juliano, 2004), knowledge loss in the software industry (Acton and Golden, 2003), knowledge retention in IT service industry (Bairi et al., 2011) and knowledge retention in the water supply industry (Blankenship et al., 2009). However, it is difficult to find any study that has investigated knowledge

retention from an individual perspective as this research focuses on individuals (consumers) as the unit of analysis, not organisations.

On the other hand, diverse studies within the digital learning space have investigated knowledge retention from the perspective of individual students. These include; medical students (Ahle et al., 2014, Balemans et al., 2016), higher education students (Kassens-Noor, 2012), architectural students (Patil, 2013), entrepreneurship higher education students (Bandera et al., 2016) and many other studies. However, one common theme across these studies is that they are focused on improving educational outcomes of students enrolled in some form of formal education. These students are thus influenced by the factors around family, academic and personal factors (Diaz, 2003) which varies from person to person, culture to culture and academic environment to academic environment (Mlambo, 2012). Some of the specific factors include; finance, formative or summative assessments, student's learning preferences, self-motivation, class attendance, previous schooling, parental involvement, parental perception and entry qualifications (Mlambo, 2012, McCoach et al., 2010). These factors however reveal some of the characteristics of student learning which makes it different from the consumer perspective being investigated in this research.

Having said that, there are lessons to be learnt from the existing studies in terms of the learning styles, as there is evidence to suggest that problem-based learning (PBL), which spans across both pedagogy and andragogy, is more effective for long-term knowledge retention, a higher-order cognitive skill, when compared to traditional learning styles such as the use of multiple choice questions (Strobel and Van Barneveld, 2009). An example of this PBL approach is a scenario-based question style.

Therefore, despite the vast literature on knowledge retention within the KM and e-learning disciplines, there is evidence to support the argument that a gap exists in the knowledge retention literature in relation to intervention programs aimed at improving domestic safe food handling behaviour of consumers but lessons can be learnt from existing learning styles.

2.1.2.3 Knowledge Application

Knowledge application, also known as knowledge utilisation, involves selecting alternatives or prioritization before taking actions or decisions based on acquired

knowledge (Verkasolo and Lappalainen, 1998). However, it has been argued that there are slight distinctions between both concepts. For instance, Skår (2010) describes the typology developed by Broudy (1964) to illustrate the modes of knowledge utilisation. In this description, the four modes of knowledge utilisation are knowledge replication, knowledge application, knowledge interpretation and knowledge association. Knowledge replication does not require processing or re-organisation of knowledge by the user. *Knowledge application requires the user to translate knowledge into recommendations so as to act in particular situations.* Knowledge interpretation requires knowledge to be rediscovered within the context of a practical situation and that one must reflect on the situation before acting. Knowledge association requires the knowledge to be used semi-consciously and intuitively. Therefore, this suggests that knowledge application is tantamount to knowledge utilisation but knowledge utilisation is not necessarily knowledge application.

There are a number of proposed theories and models for applying acquired knowledge and translating it into practice or behaviour (Graham et al., 2005, Graham and Tetroe, 2007, Estabrooks et al., 2006, Shojania et al., 2004, Wensing et al., 2005). However, the knowledge-to-action framework developed by Graham et al. (2006) appears most relevant to the research context defined in the study as it has been adopted in health-related situations. The adapted knowledge-to-action framework is shown in Figure 2-1.

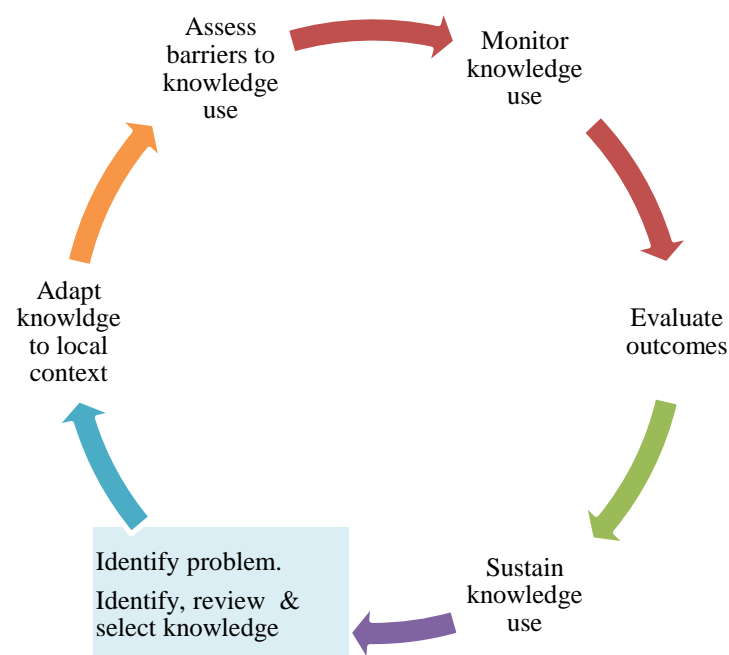


Figure 2-1: Knowledge-to-action framework

Adapted from: Graham et al. (2006)

Graham et al. (2006) describe this process as complex due to the fluid boundaries between knowledge acquisition and knowledge application. Moreover, in relation to this model, Straus et al. (2011) has argued that it is imperative to involve the end-users of the knowledge in the process to ensure the knowledge, but more importantly, its implementation is relevant to their needs.

Therefore, evidence suggests that interventions in Australia that aim to improve consumer domestic food management practices should incorporate an approach that does not only involve the consumers but targets the knowledge to their needs using an end-to-end approach, which involves knowledge on safe shopping, transportation, storage, preparation, and kitchen hygiene within the Australian context. This knowledge application process can be evaluated using the PBL approach discussed in section 2.1.2.2 as an embedded scenario-based (real life scenario) question style facilitates long term knowledge retention and the subsequent application of the acquired knowledge (Strobel and Van Barneveld, 2009).

2.1.3 Critical Reflections on Section 2.1

This section has presented an overview of the literature relating to knowledge management with reference to the research context. It started by providing an introduction to data, information and knowledge and progressed by discussing information management and knowledge management concepts. Following this, it discussed knowledge optimisation as KM based on an individual unit of analysis, by focusing on knowledge acquisition, knowledge retention and knowledge application. The findings within this section have identified the following key points and gaps in the existing body of literature;

- There is precedence for the adoption of the term knowledge optimisation rather than knowledge management in the context defined for this research.
- Whilst this research acknowledges the importance of digital pedagogical frameworks in relation to knowledge acquisition and the relevance of a few of its concepts to this research, it however argues that this research is not submerged within the digital educational research space as it is only tangentially relevant to

the context defined for this study. Nonetheless, it appears lessons can be learnt from adult learning frameworks as they appear more relevant than pedagogical frameworks.

- There is precedence for the adoption of different learning styles, including multi-choice questions and problem-based learning styles, to address various cognitive processes of Bloom's taxonomy.
- Despite the vast literature on knowledge retention within the KM and e-learning disciplines, there is evidence to support the argument that a gap exists in the knowledge retention literature in relation to intervention programs aimed at improving domestic safe food handling behaviour on consumers.
- Evidence suggests that interventions in Australia that aim to improve consumer domestic food management practices should incorporate an approach that does not only involve the consumers but targets the knowledge to their needs using an end-to-end approach, which involves knowledge on safe shopping, transportation, storage, preparation, and kitchen hygiene within the Australian context.

2.2 Information and Communication Technologies (ICTs)

This presents an overview of the literature relating to information and communication technologies (ICTs). It discusses the pervasiveness of ICTs by highlighting how much it has been embedded in human lives but more specifically food chains. It also explains mobile computing as a pre-cursor to the evolution of pervasive computing but focuses on mobile computing. Following this, it discusses the use of smartphone apps in relation to food management and in relation to usability, context of use and attributes of end-users while concluding with a critical reflection.

2.2.1 The Pervasiveness of ICT

The pervasiveness of ICT has facilitated economic, political, social and technological transformation over the years, thus resulting in a networked society organised around ICT (Castells, 2011). According to Koehler and Som (2005), pervasive computing refers to the new ways in which ICTs can be applied to daily lives. With pervasive ICT, there are a vast number of devices, usually through wireless networking technologies such as Wi-Fi, Bluetooth, 3G or 4G, and software entities that are able to communicate with

each other (Shackleton et al., 2004). More recently, pervasive computing, also known as ubiquitous computing, evolved from distributed computing and mobile computing (Saha and Mukherjee, 2003). However, all three types of computing are still undergoing continuous evolution.

As pervasive computing seamlessly integrates computers in diverse forms into human lives, by responding to information provided by sensors with little or no direct involvement from the users, it therefore offers a lot of potential applications (Ye et al., 2012). It can be applied in healthcare systems (Orwat et al., 2008), gaming, public transportation, supply chains, smart homes and intelligent workplaces (Cook and Das, 2007). For example; in supply chains, radio frequency identification (RFID) tags are easily embedded into the environment due to their lightweight, easy attachment, wireless and networked capability, thus offering many benefits for business, manufacturing and tracking processes (Stanford, 2003).

RFID tags identify tagged objects using radio waves and it is beneficial in supply chains, but more specifically food chains because of the following reasons (Aung and Chang, 2014): It does not require line of sight in reading tags; it has the ability to read and write tags; it saves time by reading many tags simultaneously; it has a higher data rate and a larger memory size. However, it has been argued that it is still plagued with the following challenges (Aung and Chang, 2014);

1. Limited sensing capability.
2. Inability of tags to initiate communication, hence it has to rely on the reader for data collection.
3. Still not cost effective.
4. Lack of cooperation among the devices.
5. It has the ability to read data within one hop only.

Thus, whilst Weiser's (1991) vision for pervasive computers involves technologies that "disappear as they weave themselves into the fabric of everyday life until they are indistinguishable from it", it appears that there are still some challenges that must be overcome such as user/device unawareness, service discovery, interoperability and heterogeneity, proactivity, privacy, security and trust (Cook and Das, 2007).

Therefore, as pervasive computing is gradually being integrated in food chains, it can be argued that it has not yet reached its maximum potentials especially in terms of the consumer-end of the chain and more broadly, in everyday use.

2.2.2 Mobile Computing

To solve problems that arise in building a distributed system with mobile clients, mobile computing was introduced (Satyanarayanan, 2001). Therefore, according to Satyanarayanan (1996), mobile computing was introduced to address constraints such as “unpredictable variation in network quality, lowered trust and robustness of mobile elements, limitations on local resources imposed by weight and size constraints, and concern for battery power consumption”. Mobile computing thus emerged by integrating cellular technology with the Web (Saha et al., 2011). On the one hand, cellular phone systems that use both handsets and the subscriber identity module (SIM) card allow users to insert their personal SIM card into any handset and use it to make and receive phone calls (Saha and Mukherjee, 2003). On the other hand, multiple users can access the same Webpage from different devices such as home or office computers, cell phones, personal digital computers and more recently, smartphones (Saha and Mukherjee, 2003). Therefore, both approaches increasingly demonstrate that the actual device is becoming less important than access to the digital world (Saha and Mukherjee, 2003); thus aligning to Weiser’s (1991) vision of pervasive computing.

In terms of mobile computing research, conducted from the perspective of the user, it has been argued that the most popular research theme is concerned with user adoption (Ladd et al., 2010). Areas that have been investigated include mobile banking (Karjaluoto et al., 2010), mobile commerce (Pedersen, 2005), multimedia messaging service (Chang and Pan, 2011) and short messaging service (SMS) (Lu et al., 2010) amongst others. These studies have focused on how their perception of mobile technology has influenced their adoption of the technology (Jung, 2014). However, there has been limited focus on the actual use, usability, context of use and attributes of the end-users in relation to each of the different areas in which mobile computing has been incorporated in recent times.

2.2.2.1 Technical Affordances of Smartphones

Smartphones have recently become the mainstream in mobile phones (Duan et al., 2014) as about 80% of Australians have smartphones and 15 million smartphones were in use

in Australia in 2015 (Drumm and Swiegers, 2015). The findings of Drumm and Swiegers (2015), reveal that the entire nation glances at their smartphones more than 440 million times a day due to the fear of missing out (FOMO). They have argued that “the smartphone has become much more than just a means to communicate – to call, to message, to link socially or in business – it has become the personal remote for life and the consumer is in control” (Drumm and Swiegers, 2015). Apart from these functions, which are usually achieved through diverse internet content and multimedia players, one of the other important functions, is the ability of users to download diverse mobile applications or ‘apps’ onto their smartphones (Jung, 2014). Through this, users can install any mobile app they choose, thus allowing them to gain control over the services their smartphones can provide to them (Verkasalo et al., 2010). This results in a highly personalised nature of smartphones as they embody a user-empowering characteristic, thus providing users with an array of capabilities and experiences (Jarvenpaa and Tomak, 2003, Tossell et al., 2012). Therefore, this has led to an increasing interest in understanding the diverse goals users achieve with their smartphones (Jung, 2014) as Yoo (2010) has argued that user adoption of smartphones may become a less significant focus of discussion.

James Gibson (1986) defined affordances as related to perceptions of the utility of an object drawn from environmental cues. In the context of this research, affordance “frames the practices through which technologies come to be involved in” (Hutchby, 2001). An “affordance” is broader than the buttons, screens, and operating systems of mobile devices (Schrock, 2015). In other words, communicative affordances are high level and not simply “bundles of features” (Majchrzak et al., 2013).

Schrock (2015) proposed 4 types of smartphone affordances and these include portability, availability, locatability and multi-mediality. He defined **portability** as the perception of physical characteristics such as size and weight, as well as those evaluated through use, such as battery life. Due to these factors, smartphones can be used in different places and contexts, as they are easily transported and carried on the body (Ito et al., 2005). **Availability** can be described as a combination of multiplexity, direct contact, and increased frequency (Schrock, 2015). Boase (2008) discussed the multiplexity of communication on smartphones which allows texting, voice calls, and social media to all become available simultaneously. Availability is, like a radio, “tuned”

(Coyne, 2010) within a user's comfort zone. Affordances can make communication possible, but it is up to individuals to use these affordances in more or less strategic ways to navigate being constantly connected (Schrock, 2015). In terms of **locatability**, GPS enabled mobile phones allowed new classes of location-based services to emerge (Wilson, 2012, De Souza e Silva and Frith, 2010). Location was "still defined by fixed geographical coordinates, but they now acquire dynamic meaning as a consequence of the constantly changing location-based information that is attached to them" (De Souza and Frith, 2012). Thus, location is not exclusively defined by GPS coordinates as individuals can, and do, say where they are located through SMS texting and phone calls (Laurier, 2001) to coordinate meetings (Ling and Yttri, 2002). Concerning **multi-mediality**, Lenhart et al. (2010) have argued that smartphones are now well known for their ability to take pictures and videos as smartphones are now being judged based on the quality of their cameras (Ito et al., 2005). Practices with multimedia slowly shifted with the introduction of higher-quality cameras as the increased deployment of digital cameras in smartphones favours the functions of communication (Van Dijck, 2008, Schrock, 2015). The integration of cameras with smartphones is in line with a rise in emotive (Hjorth, 2007) and communicative (Koskinen, 2017) visual communication that supplements and extend existing practices. Table 2-1 below reveals some examples of smartphone affordances based on the literature.

Table 2-1: Smartphone Affordances

Source: Schrock (2015)

Affordance	Communicative Practices	Examples from the literature
Portability	During commute or waiting	Ito et al. (2005)
	Domestic	Haddon (2006)
	Workplace	Wajcman et al. (2009)
Availability	Multiplexity	Boase (2008)
	Increased frequency	Licoppe (2004)
	Directness	Rainie and Wellman (2012)
Locatability	Coordination	Ling and Yttri (2002)
	Surveillance	Humphreys (2012)

	Locational identity	De Souza and Frith (2012)
Multimediality	Screen sharing	Brown and Green (2012)
	Image production	Ling (2008)
	Synchronous video streaming	Thorson et al. (2013)

2.2.2.2 Smartphone Use and Food Management

Due to the nature of this research, one of the personal uses of smartphone apps is to provide help with food, in terms of tasks such as personalized shopping experience, cooking ([The Cook App](#)) and storage ([The Home Food Storage App](#)). However, for the apps that are focused on domestic food handling practices for Australian consumers, three issues have been identified. *First*, there is evidence that the existing apps provide information in silos in relation to the various aspects (safe shopping of perishable food items, safe transportation of perishable food items, safe storage of perishable food items, safe preparation of food items and appropriate kitchen hygiene practices) of domestic SFM for Australian consumers (Henley et al., 2012), thus resulting in lack of continuity from one food handling stage to the other. *Second*, existing apps that are focused on food cooking tend not to emphasise the safety of the process; rather, the focus is usually on the recipe. *Third*, existing apps provide very limited information to address safe transportation from the point of purchase to the consumer's home and subsequent kitchen hygiene practices. Therefore, *there is a need for a smartphone app that seamlessly integrates all the different stages of safe food handling while addressing each stage with a focus on safety for Australian consumers.*

2.2.2.3 Smartphone Apps and Usability, Context of Use and Attributes of End-Users in Safe Food Management

Within the Information Systems (IS) discipline, a lot of research has been conducted on public health issues in terms of child health (Knapp et al., 2011), immunisation (Heijbel and Jefferson, 2001), injury prevention (Weber et al., 2008), alcohol (Elliott et al., 2008), mental health (Luxton et al., 2011), primary health (Schoen et al., 2012), women's health (Lev, 2009) and general health promotion (Lintonen et al., 2008). However, there has been little focus on food management and food safety issues from

the IS perspective. To address this gap, this research explores usability and health literacy as themes that facilitate the adoption, success and sustainability of a health information system.

According to ISO 9241-11, usability is defined as the “extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use” (ISO, 1998). On the other hand, Rootman and Gordon-El-Bihbety (2008) defined health literacy as “the ability to access, understand, evaluate and communicate information as a way to promote, maintain and improve health in a variety of settings across the life-course”. Thus, usability is concerned with the interaction between the interface and the consumer while health literacy largely deals with the informational content (Monkman and Kushniruk, 2013). Whilst Monkman and Kushniruk (2013) have argued for the existence of an intrinsic relationship between usability and health literacy, they have also argued that if health consumers cannot understand the content of a system, the system will not be efficient, effective nor satisfactory. Therefore, it is imperative for consumer health information systems to be designed with considerations for usability and consumers that have limited health literacy. Thus, in this paper, the term “health literacy” is used as a proxy for the end user’s skills and attributes in relation to their understanding of the information content within the food safety context.

Within the food safety context and due to the increasing use of smartphone applications, diverse food safety apps have been developed to mitigate consumer health risks (McMahon et al., 2013, Cho et al., 2013) due to the alarming rate of domestic food poisoning caused by poor food handling practices (Bamgboje-Ayodele et al., 2015). Despite the large number of available food safety apps, there is a dearth of research that assesses how well the app has been designed for consumers with considerations for usability (Oliveira et al., 2013), the context of use and attribute & behaviour of end users. In addition, most of these apps have not been able to provide significant evidence to suggest that consumers indeed understand the information, can retain the knowledge acquired over time and can behave in a manner that corresponds to the acquired knowledge, in this case – safe food management. These suggest that there is a need for a holistic evaluation of existing food safety apps most especially from the consumer perspective.

In summary, it can be argued that there is insufficient evidence that the few existing apps that have attempted to address one, some or all of the different stages of the consumer food handling practices from the point of purchase till actual consumption have been evaluated. The few apps that have however been evaluated are largely focused on the usability of the app whilst many have failed to unpack the inter-relatedness of usability, context of use and attribute & behaviour of the end-users; all of which are fundamental to the holistic evaluation of such apps.

2.2.3 Human-Computer Interaction (HCI) Design Approaches

As described by Eberts (1994), there are four HCI design approaches that may be applied to user interface designs when developing applications for people. These include; the Anthropomorphic Approach, the Cognitive Approach, the Predictive Modelling Approach, and the Empirical Approach. Each of these will now be discussed in relation to this research;

2.2.3.1 Anthropomorphic Approach

The anthropomorphic or ethnographic approach to human-computer interaction focuses on the importance of observing the users in their “natural-setting” whilst they are conducting relevant tasks or activities in real-life contexts (Hughes et al., 1997). This helps to ensure that the system is designed for real world users (Rogers and Bellotti, 1997). Within this approach, usability studies are conducted to highlight anthropomorphic design characteristics by using human-human communication as a model for human-computer interaction (Eberts, 1994). However, it has been argued that some human-human communication cues such as facial expressions and gestures are not easily incorporated into HCI design (Cuevas, 2004).

In relation to this project, this approach was deemed unrealistic due to the resource constraints which this PhD research was bound by and the need to avoid the Hawthorne effect. First, in terms of time constraints; an ethnographic approach would require significant amounts of time to directly observe participants during the shopping, transportation, storage, preparation and consumption processes as required by this study. Second, in terms of financial constraints; this approach would require a sizeable amount of financial resources to encourage participants to participate in such a study. It would also require significant financial resources to organise direct observations during such a lengthy process of “purchase-to-plate” which could span across varying amounts of time

depending upon the circumstances of each participant. Third, this approach has the potentials to introduce the Hawthorne effect into this study as the presence of an observer could influence the behaviour of the participants (Leslie et al., 2014) during the purchase to plate process.

2.2.3.2 Cognitive Approach

The cognitive approach to human-computer interaction involves the consideration of the human-brain and sensory capabilities so as to develop an interface that supports the user (Cuevas, 2004). There are a number of cognitive based techniques that are utilised in this HCI design approach. An example is the use of metaphoric designs which involves incorporating metaphors and analogies into the design. The aim of this approach is to facilitate the learning of system functions by making abstract concepts more real (Eberts, 1994). Metaphors rely on a user's familiarity with the concept being represented, as well as human affordances; to help users understand possible actions in relation to their data and the form it is presented. However, this approach can be problematic when users expect a metaphor to be fully represented in a design but only part of the metaphor has been implemented (Eberts, 1994).

In the context of this project, it can be argued that metaphors can be used to improve the intuitiveness of the interface in terms of learnability and memorability (Cuevas, 2004). However, there was a need to ensure that users do not have an inaccurate belief regarding the actual purpose and behaviour of the application. More specifically, it is important for users to understand that a smartphone application or other smart devices, such as smart microwaves and smart fridges would not be in charge of physically handling their food safely from 'purchase to plate'. As this project is focused on empowering consumers to take responsibility for the safety of the food products from purchase to plate, incorporating this design approach could cause some level of confusion for the users if they approach an application with the belief that it would resolve all food safety problems.

2.2.3.3 Predictive Modelling Approach

This is a method for examining each component of user experience in relation to the time it takes a user to most efficiently complete a goal. This involves modelling the user's actions while interacting with the system by providing detailed analysis of the task and accurate estimation of the processing times and errors (Cuevas, 2004).

According to Card et al. (1983), an example of this approach is to use the GOMS (Goals, Operators, Methods and Selection Rules) model which involves specifying the task's goals; identifying operators needed to execute the task, specifying the method for accomplishing the goals and indicating how the methods and operators are executed.

In the context of this research, this approach is not applicable as the aim of the food safety application is not to reach an “in-app” goal. The aim of the application is for the users to gain safe food management knowledge which can later be applied during the purchase-to-plate process. This can be done at first use or incrementally as each user has their own pace (Ashton-Hay, 2005).

In addition, it is particularly important not to use this approach as this project does not encourage users to be “technology-dependent” during domestic food handling processes as this negates the primary purpose of ensuring the safety of the process. As such, it is unrealistic for end-users to continually use apps during most of the five-stage processes (transportation, preparation and kitchen hygiene). For instance, for safe food preparation, using a smartphone app in a kitchen environment may contribute to a higher risk of cross contamination, as it has been argued that mobile phones are one of the biggest carriers of bacteria (Parhizgari et al., 2014, Orsi et al., 2015), thus making the food being prepared potentially unsafe for consumption.

2.2.3.4 Empirical Approach

The empirical approach to human computer interaction involves examining and comparing multiple conceptual designs. It is argued that this approach helps to determine optimal HCI design features and characteristics (Eberts, 1994). This approach involves: formulating an empirically testable hypothesis, identifying the target population, choosing the design features to be manipulated, outcomes to be measured and finally, selecting the appropriate analytical procedures for evaluating the results. This approach helps to provide insights and draw valid conclusions about which design and user characteristics is optimal (Cook et al., 2002).

In this context of this research, it has been earlier argued in section 2.2.2.3 that there is a need for a holistic evaluation of existing food safety apps most especially from the consumer perspective. Therefore, evaluating existing food safety applications using this

approach has the potential to identify design features and characteristics that are most applicable to the safe food management context defined in this study.

2.2.4 Usability and Health Literacy

According to ISO 9241-11, usability is defined as the “extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use” (ISO, 1998). However, Nielsen (2003) argued that “usability is a quality attribute that assesses how easy and pleasant user interfaces are. It also refers to methods for improving ease-of-use during the design process”. Within usability studies, utility involves determining whether the design provides the required features. Usability testing is an approach which determines the usefulness of a product where usefulness encapsulates usability and utility (Rogers et al., 2011b, Nielsen, 2003). At the basic level, the five components of usability include (Nielsen, 2003); learnability, efficiency, memorability, errors and satisfaction. Learnability is the ease with which a user accomplishes basic tasks while encountering the design for the first time. Efficiency is the timeliness through which a task can be accomplished by a user. Memorability is the ease with which a user can easily regain proficiency after a long period of time. Errors, as the name suggests, is the identification of problems, its severity and the ease of recovery from such errors. Satisfaction deals with the pleasantness of the design from the perspective of the user. The main objective of usability testing deals with ensuring the product meets the actual needs of the intended audience – in this case the consumers (Rogers et al., 2011b).

As it has been argued that domestic safe food management is a public health issue, the importance of health literacy, within this context, cannot be over-emphasised. Rootman and Gordon-El-Bihbety (2008) defined health literacy as “the ability to access, understand, evaluate and communicate information as a way to promote, maintain and improve health in a variety of settings across the life-course”. Thus, usability is concerned with the interaction between the interface and the consumer while health literacy largely deals with the informational content (Monkman and Kushniruk, 2013). Whilst Monkman and Kushniruk (2013) have argued for the existence of an intrinsic relationship between usability and health literacy, they have also argued that if health consumers cannot understand the content of a system, the system will not be efficient,

effective nor satisfactory. Therefore, it is imperative for consumer health information systems to be designed with considerations for usability and consumers that have limited health literacy. Thus, in this study, the term “health literacy” is used as a proxy for the end user’s skills and attributes in relation to their understanding of the information content within the food safety context.

With an increasing use of mobile technology but more specifically smartphone applications (apps) and an alarming rate of domestic food poisoning due to knowledge gaps, diverse food safety apps have been developed to mitigate consumer health risks. Despite the large number of available food safety apps, there is a dearth of research that assesses how well the content of the app has been designed for consumers with considerations for both usability and health literacy. The few evaluations that have been conducted have been restricted usability assessments such that questions about the importance of contexts of use and the attributes and behaviours of end-users have been marginalised. To address this concern, Monkman and Kushniruk (2013) adapted a set of existing guidelines for the design of consumer health Web sites (DHHS, 2010, DHHS, 2007) into evidence-based evaluation heuristics tailored specifically for mobile consumer health applications. Whilst they have tested the heuristics by evaluating a single mobile consumer health app from an expert’s perspective, such assessment is not sufficient to address issues about the contexts of use and the attributes and behaviours of end-users without consulting the consumers. This is based on the argument provided by Tullis and Wood (2004) who believe that findings based on the smallest sample sizes provide more useful insights than speculations by a designer or an expert who is not a potential user of the app for which it is being developed. Therefore, it is imperative to address these issues by adopting a health literacy online heuristics (HLOH) framework and combining it with a consumer-based evaluation to holistically assess the usability of consumer health applications, their contexts of use and attributes of the end-users.

As Rogers et al. (2011b) have noted, usability evaluation is beneficial because it allows comparison of different prototypes and/or designs; provides an understanding of the experience of users with the product and it also evaluates the efficiency of the product. More interesting is the fact that this usability evaluation can be applied from any philosophical stance (positivism, interpretivism or pragmatism); hence it allows an array of data collection approaches such as laboratory testing, questionnaires, focus groups,

scenarios or interviews. Concerning the disadvantage, Hughes (1999) has highlighted the fact that the ability to use diverse methods calls for a high level of care in order to ensure its validity and reliability. In this study, a high level of care was taken during the conduct of the research.

2.2.5 Critical Reflections on Section 2.2

The sub-sections within section 2.2 have presented an overview of the literature relating to information and communication technologies (ICTs). It has discussed the pervasiveness of ICTs by highlighting how much it has been embedded in human lives but more specifically food chains. It has also explained mobile computing as a precursor to the evolution of pervasive computing. Following this, it has discussed the use of smartphone apps in relation to food management and in relation to usability, context of use and attributes of end-users while concluding with a critical reflection on the section. The findings within this section have identified the following key points and gaps in the existing body of literature;

- As pervasive computing is gradually being integrated in food chains, it can be argued that it has not yet reached its maximum potentials especially in terms of the consumer-end of the chain and more broadly, in everyday use.
- There has been limited focus on the actual use, usability, context of use and attributes of the end-users in relation to each of the different areas in which mobile computing has been incorporated in recent times.
- There is a need for a smartphone app that seamlessly integrates all the different stages of domestic safe food handling while addressing each stage with a focus on safety for Australian consumers.
- There is insufficient evidence that the few existing apps that have attempted to address one, some or all of the different stages of consumer food handling practices from the point of purchase till actual consumption have been evaluated. The few apps that have however been evaluated are largely focused on the usability of the app whilst many have failed to unpack the inter-relatedness of usability, context of use and attribute & behaviour of the end-users; all of which are fundamental to the holistic evaluation of such apps.

2.3 Consumer Behaviour

This presents an overview of the literature on consumer behaviour with reference to the research context. It starts by providing an introduction to consumer behaviour and progresses by discussing communication from an information modality perspective. Following this, it presents a review of the peculiarities of consumer food information processing which leads to a discussion of consumer food behaviour. Subsequently, risk communication and ICT is discussed in terms of information presentation information content, information delivery channels and information sources while concluding with a critical reflection.

2.3.1 Introduction to Consumer Behaviour

Consumer behaviour entails the whole of consumers' decisions with respect to acquisition, consumption and disposal of product offerings such as goods, services, time and ideas, by human decision making units over a period of time (Macinnis, 2004). While Solomon et al. (2009) believe consumer behaviour is an applied science, they also regard it simply as the study of people and the products that help in forming their identities.

At the basic level, Macinnis (2004) believes that consumer behaviour is concerned with four domains. These include the psychological core, consumer culture, decision making process and consumer behaviour outcomes. The rationale is that, before a consumer makes the final *decision* to *purchase* a product or adopt an offering (behaviour outcome), there are *internal* (psychological) and *external* (consumer's culture) processes that influence such decision. The internal processes rely on some sources of information and knowledge which serves as the foundation of their decisions. The sources include motivation, ability and opportunity; exposure, attention and perception; categorization and comprehension of information as well as formation and attitude change. The external processes refer to the defining culture of the consumer. Culture is known as the expected norms, attitudes and ideologies that characterise a set of people (Spencer-Oatey and Franklin, 2012). Culture has a powerful influence and can affect human decisions, how information is processed and communicated as well as all aspects of human behaviour. Hence, regional, religious, ethnic, social class, age, gender, household and psychographics are potential influences of consumer decision making processes. Figure

2-2 below shows the conceptual framework of the aforementioned consumer behaviour framework.

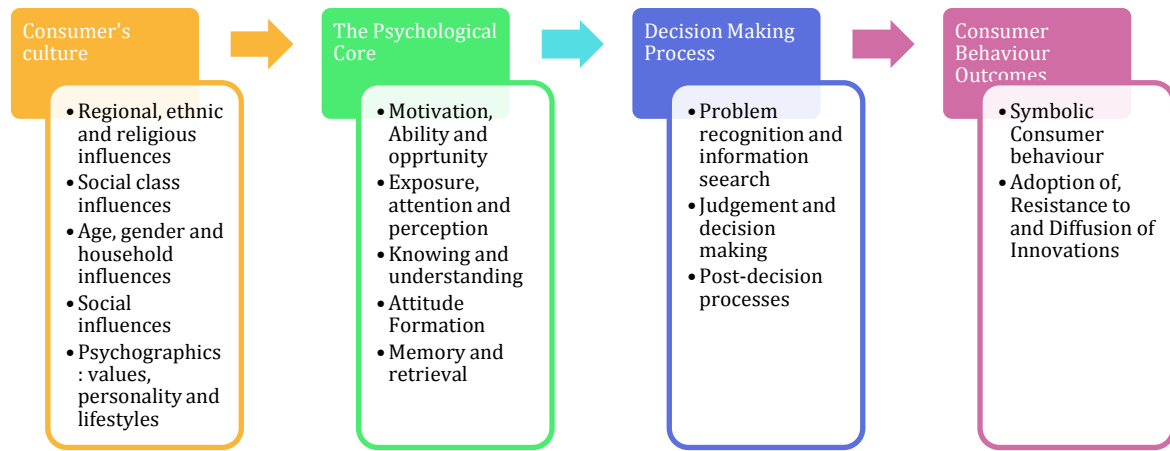


Figure 2-2: Consumer Behaviour Framework

Source: Macinnis (2004)

It is however interesting to note that, in this framework, a large part of the decision making process depends on the information and knowledge available to the consumer. While it can be argued that so much information causes information overload, it can also be argued that lack of or insufficient information could be problematic as reflected in the literature on safe food management (see section 2.1.4). In view of this, Macinnis (2004) and Solomon et al. (2009) argued that perceived risk heavily influences consumer involvement. Hence, in the context of this research, it is expected that consumers might engage in active external information search activities because of the perceived risk of food poisoning.

2.3.2 Communication: An Information Modality Perspective

“Effective communication requires two or more people to have a topic of mutual interest, a mutual desire, intent or need to communicate about the topic, the opportunity to communicate and the means of communicating” (O’Toole, 2016). Senders of messages are those who express information based on their thoughts, agenda, feelings or emotions at a given time while receivers of messages are those who constitute the audience and receive the information (O’Toole, 2016). Viewing communication in this perspective reveals that there are factors that are unique to the sender, those that are

unique to the receiver and those that are external to the sender and receiver. Examples of these factors are as follows;

- Unique to the sender – Emphasis on a particular word (Crystal, 2007).
- Unique to the receiver – Knowledge and associated levels of understanding (Honeycutt and Milliken, 2012), age (O'Toole, 2016), cultural/language background (Fageeh, 2011), individual disorder and individual interpretation according to their thoughts, ideas, needs and emotions at that given time (O'Toole, 2016).
- External to the sender and receiver – Context of the situation and environment (Nunan, 2012) or background and experiences (Purtilo et al., 2014).

Within the public health domain, health communication has emerged for achieving public health objectives such as persuading and motivating people to adopt behavioural changes (Bernhardt, 2004). Hinyard and Kreuter (2007) have argued that health communication researchers increasingly utilise narrative forms of communication such as story-telling, and testimonials to help achieve the same objectives. According to Hinyard and Kreuter (2007), *“A narrative is any cohesive and coherent story with an identifiable beginning, middle, and end that provides information about scene, characters, and conflict; raises unanswered questions or unresolved conflict; and provides resolution.”* Narrative communication involves the use of different types of stories to convey information to a receiver or to receive information from a source. These stories could be **official stories** constructed to tell a mild version of events; **invented stories** that are fictional; **firsthand** experiential stories; **second-hand stories** of others that are retold, and **culturally common stories** that are generalized and pervasive in a cultural environment as identified by Schank and Berman (2003).

It has been argued that narrative communication has the following advantages (Hinyard and Kreuter, 2007): (a) Narratives help overcome resistance to a message by reducing counter-arguing; (b) narratives facilitate observational learning; and (c) identification with characters in a narrative influences perceptions of group and/or personal susceptibility as well as social norms. Narrative processing is based on the transportation-imagery model and the extended Elaboration Likelihood Model (ELM) model. According to the transportation-imagery model, narrative persuasion occurs because the receiver is “transported” into the narrative world thereby causing them to

absorb the story to the extent that they are less likely to counter-argue because the story is more like an actual experience (Green, 2004, Van Laer et al., 2013, Green and Brock, 2002). On the other hand, the extended ELM model states that a person's processing goals establish the type of processing that will take place; and that determinants of processing intensity, such as a person's motivation, are responsible for the degree of involvement within each type of processing (Slater, 2002). This means that, for an individual to engage with a narrative message the narrative must serve the needs and the goals of the receiver. Both models thus agree that inhibition of counter-arguing, identification with story characters, and transportation or engagement with the narrative increase the persuasiveness of the narrative (Green and Brock, 2002, Slater, 2002).

Due to the importance of information (Kim and Lennon, 2000), which consumers acquire from different sources, whether appropriate or not, government authorities and businesses have continuously tried to change consumer attitudes by employing different communication models but more specifically narratives in order to achieve their intended purpose. The basic components of communication entails *the source*, *the message* and *the medium* of communication which could be via television, radio, magazines, billboards, personal contacts and others (Solomon et al., 2009).

The media has however evolved, as the proponents of *uses and gratifications theory* have stressed that the mass media contend with other sources in order to fulfil consumer needs such as distraction, entertainment and information (O'Donohoe, 1994, Stafford et al., 2004). Based on this, cell phones, PDAs (personal digital assistants), iPods, tablets, blogs such as m-blogging, video blogging, podcasting, RSS (really simple syndication) and flogs (fake blogs) have become tools which businesses use to promote their products (Solomon et al., 2009). Narratives may be communicated through a wide range of media as listed above but it has been argued that different media affect both the way narratives are processed and their effectiveness (Hinyard and Kreuter, 2007). For example; Pfau et al. (2000) have shown that visual media emphasise the importance of source attributes. This suggests that character identification might be facilitated in a video-based narrative. Character identification is one of the key elements of the transportation imagery theory.

According to Solomon et al. (2009) **the source** of a message has the potential to influence the acceptance or rejection of a message. An important characteristic of the source of a message has to do with credibility which is known as the perceived expertise,

objectivity or trustworthiness of a source. The source credibility has been heavily researched in the literature for over five decades under the disciplines of consumer behaviour and social psychology (Pornpitakpan, 2004). It is widely believed that a source with high credibility induces more persuasion towards a cause than a source with low credibility (Hovland and Weiss, 1951, Horai et al., 1974, Johnson and Izzett, 1969, Schulman and Worrall, 1970, Maddux and Rogers, 1980, Lirtzman and Shuv-Ami, 1986).

In relation to **the receiver**, it has been argued that attributes of the intended audience may influence the effect of narrative communication (Hinyard and Kreuter, 2007). For instance, research within the narrative transportation domain has revealed that a person's ability to create vivid mental images and his or her propensity for absorption can facilitate narrative persuasion (Green and Brock, 2002, Green, 2004). In the same vein, culture might affect the impact of narrative communication as every culture contains several dominant stories that are understood by those within the culture; and it is drawn upon to make meaning out of different situations under different circumstances (Hinyard and Kreuter, 2007).

The message and its characteristics have the potential to influence consumer attitudes as the “*what*” of the message and “*how*” the message is conveyed are powerful variables (Solomon et al., 2009). The debate here has largely concerned the textual, verbal and visual component of advertisements – *information modalities*. According to Solomon et al. (2009) it is believed that a picture can deliver a big impact in an economic manner but it is not always effective when communicating factual information. On the other hand, it has been argued that verbal messages are more appropriate for *high-involvement situations* but is more difficult to process and typically erodes easily in memory hence it requires more frequent exposures in order to achieve the intended purpose. Therefore, it is sometimes more effective to accompany visual elements with the verbal ones (Hirschman and Solomon, 1984). Characteristics of the visual and verbal elements include; vividness (Rossiter and Percy, 1980, Kisielius and Sternthal, 1986, Keller and Block, 1997), repetition (Zajonc, 1968, D'Souza and Rao, 1995, Belch, 1982, Bornstein, 1989), argument construction (Golden and Alpert, 1987, Sawyer, 1973) and drawing conclusions (Kardes, 1988).

In order to investigate the influence of product presentation format (visual or verbal) on consumer shopping in an online store, the results of the study conducted by Kim and Lennon (2008) showed that only verbal information had a significant effect on purchase intention, though visual information was also important. According to the study on visual merchandising cues (VMD) by Ha and Lennon (2010), the results indicate that VMD cues increase consumer satisfaction, purchase intention, and approach behaviour. It is worthy of note here that visual merchandising can be referred to as the strategic presentation of a company and its products in order to attract consumers and facilitate purchasing via merchandise presentation, store design, mannequins, props and materials, lighting, graphics, and signage (Diamond and Diamond, 2008). Internet shopping researchers have recently focused on VMD due to the belief that more attractive and pleasurable website has the potential to influence the behavioural intention of a consumer (Szymanski and Hise, 2000, Wu et al., 2008, Ha and Lennon, 2010).

Within the same discourse, a study by Blanco et al. (2010) reveals that a schematic display of textual information improves perceptions of information quality. Hence, the combination of a picture and textual information, helps users in remembering more information easily especially when the information appears schematically. However, the absence of a product picture causes users to expend more resources in processing paragraph information but makes them recall more information easily; thus aligning with the results of the study by Kim and Lennon (2008).

In another study by Lin et al. (2012), while investigating the influence of visual information on consumers' perception of electronic word of mouth (eWOM) message quality, credibility, product interest, and purchase intention via the use of blogs, the results indicate that the respondents rated eWOM articles with visual information significantly higher in perceived message quality, credibility, consumers' product interest and purchase intention than identical articles without visual information. eWOM communication occurs via the use of web-based technologies in order to post text reviews and product pictures online while seeking product recommendations (Lin et al., 2012).

Though numerous research have been conducted within the human and computer interaction (HCI) sub-discipline on the impact of diverse *information modalities* on consumer knowledge, yet it is still unclear how the acquired knowledge can be translated

to corresponding behaviour. *In addition, while there are supporting and contradicting arguments within the literature, there is one area where there seems to be an agreement; the importance of information presentation.* Hence, it is much clearer that the way information is presented to consumers can influence consumers' reaction. As the studies highlighted above were largely conducted within the information systems (IS) discipline but without reference to the safe food management context defined in this study, it is imperative to consider food-related studies and gaps that exist in the literature within this discourse.

2.3.3 Consumer Information Seeking Behaviour

Thomas Wilson's (1999) model of information behaviour describes the process of information seeking as a system in which an information seeker operates. Wimberley and McClean (2012) summarises the model by stating that *"information-seeking behaviour arises as a consequence of a need perceived by an information user, who, in order to satisfy that need, makes demands upon formal or informal information sources or services, which result in success or failure to find relevant information. If successful, the individual then makes use of the information found and may either fully or partially satisfy the perceived need—or, indeed, fail to satisfy the need and have to reiterate the search process"*. The model also suggests that information seeking behaviour includes relating with other people through information exchange as information people perceive is useful may be shared with other people or used by them. Therefore, information seeking involves deliberate inquiry which results in using and/or exchanging the knowledge learnt (Wimberley and McClean, 2012).

In relation to the context of this study, health information seeking refers to deliberate efforts to obtain specific health information beyond the normal patterns of information exposure and use of interpersonal sources which differentiates it from information scanning (Zhao and Zhang, 2017). The three main reasons for consumer health information seeking are individual health care, medical treatment and public health concerns (Deering and Harris, 1996). As food safety, food quality, food provenance, food recall issues are some of the public health concerns that may instigate consumer health information seeking behaviour, it is imperative to ensure that relevant information is disseminated in a manner that is applicable to the population in focus. Therefore, to

address this issue, the following considerations for information dissemination are discussed under risk communication;

- Information presentation – see section 2.3.6.1 sub-section A
- Information content - see section 2.3.6.1 sub-section B
- Information delivery channel - see section 2.3.6.1 sub-section C
- Information source - see section 2.3.6.1 sub-section D

2.3.4 Consumer and Food Information Processing Peculiarities

Drawing on McGuire's (1976) information processing model which suggests that understanding precedes retention, and retention precedes action, one of the objectives of this research concerns ensuring any food safety intervention is indeed understandable to the consumers, before expecting that the knowledge can be retained and then taking steps to facilitate a change in consumer food handling behaviour. However, despite the relevance of this and similar models, studies such as Leathwood et al. (2007), Verbeke et al. (2009), Grunert et al. (2009), van Trijp (2009) have largely focused on evaluating consumer understanding of nutrition information labels and claims, thereby concentrating on low involvement decisions which tends to occur at the point of purchase – this is similar to the aforementioned non-food related studies. As van Trijp (2009) as earlier argued, food choice decisions are examples of *low involvement* decisions which is characterised by limited investment of time and effort into information processing. *Low involvement* decisions do not usually involve high levels of perceived personal relevance and risk of wrong decisions (van Trijp, 2009, Hamlin, 2010, Insch and Jackson, 2013). Thus, the process of routine grocery shopping by a consumer is classified as a low involvement task. As a result, it has been argued that consumers tend to base their food choices on peripheral, simple to interpret information rather than detailed information (Petty and Cacioppo, 1986).

On the other hand, there is little research on consumer understanding of food safety information, that places emphasis on post-purchase domestic food handling and management which may well be a *medium to high involvement* task. Whilst this requires further investigation, the rationale for positing that post-purchase domestic food handling and management may be a medium to high involvement task, is this. It appears

domestic food handling post-purchase transits beyond the level of low involvement tasks to medium and high involvement tasks and the different variations in-between, based on the knowledge, skills and experience of the consumer on food management and handling. For knowledgeable, skilled and experienced consumers who are domestic food handlers, who tend to be characterised as good cooks; their process of food handling and preparation is usually based on peripheral processing thus they do not tend to think that food handling and preparation information is objectively personally relevant to them (Dijkstra and Ballast, 2012) but they know that the mismanagement of food products at home can compromise its safety which can lead to food poisoning. It is therefore argued that this group of consumers may make medium involvement decisions based on their low level of perceived personal relevance due to their skills and experience; and their awareness of the risk of wrong decisions due to their knowledge of food safety.

In contrast, naive, unskilled and inexperienced consumers who are domestic food handlers tend to be characterised as learning cooks; their process of food handling and preparation tend to rely on detailed information such as recipe instructions in its various information modalities (booklets – textual, podcasts – verbal, TV shows or online videos - integrated) as they think that food handling and preparation information is objectively personally relevant to them (Dijkstra and Ballast, 2012); and they often do not know that the mismanagement of food products at home can compromise its safety as recipe instructions tend to focus on ingredients, cooking method and time rather than the safety of the entire process from the point of purchase till its actual consumption. Thus, it is argued that this group of consumers may make high involvement decisions based on their high level of perceived personal relevance due to their lack of skills and experience; and their high risk of wrong decisions due to their food safety knowledge gaps.

Therefore, to conduct this investigation, it is important to explore consumer food behaviour as this is important for the context defined in this study.

2.3.5 Consumer Food Behaviour

From a broad perspective, Steenkamp (1997) and Liu et al. (2013) have argued that consumer behaviour is influenced by four main factors: personal, economic, socio-

cultural, and marketing. But more specifically, Mateus et al. (2014) argued that consumer food safety behaviour is influenced by cultural factors, socio-economic and environmental, as well as psychological determinants, such as knowledge, attitudes, beliefs and values. This suggests that researchers have drawn on social cognitive theories in order to better understand consumer food safety behaviour. Thus, when food safety information intervention is being developed, the aforementioned factors should be considered (Van Boxtael et al., 2014) since food safety information is received and used differently by different consumers.

At the national level, during a pre-intervention study, it has also been argued that food safety information interventions should be targeted towards the appropriate audience, thus leading to arguments about consumer clusters/segments/categories. It has been realized that categorizing consumers based on demography and some of the other generic segmentation variables are becoming less useful in explaining consumer behaviour (Grunert et al., 1993, Wedel et al., 2000) and that food-related lifestyles could be more valuable. Thus, in studies conducted by Brunsø et al. (2002) and Grunert et al. (2001) in European countries such as France, England, Denmark and Germany, by Askegaard and Brunsø (1999) in Singapore, and by Reid et al. (2001) in Australia; five major categories of consumers have been identified based on the consumers' food-related lifestyle. These include; the uninvolved consumer, the careless consumer, the conservative consumer, the rational consumer and the adventurous consumer.

The other categories include; the pragmatic consumer, the hedonistic consumer, the moderate consumer and the eco-moderate consumer. According to Askegaard and Brunsø (1999), the five areas in the food related lifestyle model concerns ways of shopping, cooking methods, food quality, consumption situation and purchasing motives. Table 2-2 below describes the characteristics of each of the food consumer segments.

Table 2-2: Food consumer categories

Source: Brunsø et al. (2002)

	Consumer Category	Description
1	Uninvolved	Weak purchase motives for food
		Limited interest in food quality
		Mostly prefers convenience

		Fails to read product information
		Limited interest in price
		Little interest in cooking
		Tend to be single, young, employed, have average to low level income and live in big cities
2	Careless	Weak purchase motives for food
		Low interest in food quality
		Interested in novelty, hence they tend to buy new products spontaneously, once it does not require better or new cooking skills.
		Typically young and often live in big cities
		More educated than the uninvolved and tend to earn more
3	Conservative	Traditional meal patterns is a major purchase motive
		Health conscious
		Taste conscious
		Not particularly interested in convenience
		Tend to have the highest average age, least educated
		Smaller households, typically in rural areas and generally smaller incomes
4	Rational	Process a lot of food information while shopping
		Interested in all aspects of food quality
		Major purchase motives are self-fulfilment, recognition and security
		Tend to have planned meals
		Typically more women with families
		Tend to live in medium-sized towns and a good number usually do not work
5	Adventurous	Typically have a little above average interest in food quality
		Highly interested in cooking and tends to involve the whole family
		Not interested in convenience
		Highly interested in food quality
		Taste conscious
		Major purchase motive is self-fulfilment in food
		Typically from the younger part of the population, with an above average household size.
		Highest educational level, high incomes and tend to live in big cities.
6	Pragmatic	High interest in health related food information

		High interest in organic food information
		Interested in convenience and snacking
7	Hedonistic	Resembles the adventurous
		Stronger emphasis on pleasurable food
8	Moderate	Expresses an average attitude to all aspects of food related lifestyle
9	Eco-Moderate	Organic production is the only aspect they are interested in.

It is expected that there will be some differences associated with diverse countries; therefore this list just provides an idea of what has existed concerning food consumer categorization in the literature. Hence, it should not be regarded as a perfect consumer categorization. It is also expected that there may be some consumers that will reflect more than one of these categories.

Based on the classification highlighted above Reid et al. (2001), conducted a cross-cultural study on the food-related lifestyle in Australia, Singapore, Britain, France and Denmark. The result of their study suggests that Australians are different from other countries in the following ways highlighted in Table 2-3 below.

Table 2-3: Australian Food Consumer Category

Adapted from: Reid et al. (2001)

Food Related Lifestyle Construct	Description	Suggestive Category of Australian Food Consumers
Ways of shopping	Less likely to watch for price changes and less likely to take advantage of store specials	Uninvolved
Food Quality	More likely to seek value for money, more likely to try new recipes and new food, less likely to focus on taste	Adventurous, Careless
Ways of cooking	More likely to seek new cooking methods, less likely to consider the kitchen as women-only and more likely to involve the whole family in cooking	Adventurous
Consumption situation	More likely to consider food in social events, more likely to go out for dinner as regular dining habits, more likely to prepare casual dinner with friends	Hedonistic, Adventurous
Purchase motive	Less likely to focus on unfamiliar or 'comfort foods', less likely to have conservative or traditional eating habits.	Rational, Adventurous

Despite the fact that the data from which the above classification was drawn is quite old, at the very basic level, it suggests the likely categories of Australian food consumers. However, it is also likely that Australian consumers have changed in their eating habits over the years due to health-related, environment-related and other socio-economic and personal reasons. Hence, it seems reasonable not to discard the above five major categories and to include the four other categories, as Australian food consumers might have evolved to the level at which they emanate the attributes in those non-major categories (pragmatic, hedonistic, moderate and eco-moderate). In addition, it is likely that Australian consumers may self-report perceived behavioural changes that are not necessarily accurate; thus these findings should be utilised with caution.

Therefore, while these findings can be leveraged for the context of this study, it also suggests that it is imperative to investigate the norms, attitude and behaviour of the target audience (consumers) in relation to food but more specifically food handling and management practices.

2.3.6 Risk Perception, Risk Communication and ICT

Risk is defined as “a combination of the probability, or frequency, of occurrence of a defined hazard and the magnitude of the consequences of the occurrence” (Royal_Society, 1992). In the context of food safety, the analysis of risk could begin with the identification of food hazard (Yeung and Morris, 2001). Hazards associated with food consumption can be classified into three sources of risk; microbiological, chemical and technical. According to Yeung and Morris (2001), microbiological hazards include all hazard caused by bacteria such as Salmonella, Campylobacter coli, Listeria monocytogenes, and Escherichia coli; chemical hazards are caused by chemical additives, processes and controls in food industries; and technological hazards are concerned with possible negative consequences of technological advancements in food products. The following sub-section describes risk perception from the consumer perspective before progressing to discuss risk communication from the ICT perspective.

2.3.6.1 Risk perception

Yeung and Morris (2001) have argued that risk perception is mainly determined by the social and psychological characteristics of the food hazard. Their argument was based on

the previous work of Slovic et al. (1980) who have defined these social representations of food risk as risk characteristics. Slovic (1987) further suggested a set of risk characteristics to explain consumer perception, such as severity of consequences, control over risk, immediacy of effect, voluntariness of risk, knowledge about risk, newness, chronic-catastrophic, common-dread. For example, they consistently demonstrated that consumers' perception of risk as involuntary, potentially catastrophic, or uncontrolled will increase their public risk perception (Slovic, 1992). Also, it is unlikely for people to tolerate risk if they perceive there is no benefit to hazard exposure and if they believe there is an inverse relationship between risk and benefit (Frewer et al., 1997). In addition, for risks to be acceptable to consumers, the benefits must be perceived to accrue to those exposed to the risks (Frewer, 2000). However, Frewer (2000) have argued that providing risk information estimates may not necessarily influence the way people think about hazards. More specifically, providing risk information that does not address consumers concerns and does not include the social context in which the information is embedded, may be disregarded by the receiver of the information. Therefore, this shows the importance of appropriate risk communication strategies.

2.3.6.2 Risk Communication

Drawing on the principles of risk communication, CAC (2003b) defined it as “the exchange of information and opinions concerning risk and risk-related factors among risk assessors, risk managers, consumers and other interested parties”. The FAO (1999) thus stated that the ultimate goal of risk communication is “to provide meaningful, relevant and accurate information, in clear and understandable terms targeted to a specific audience”. Therefore, information dissemination within this context is about ensuring that the information being shared indeed achieves the intended purpose.

From the perspective of food safety intervention, information dissemination refers to all the considerations that will facilitate the actual sharing of food safety information with consumers. These considerations include information presentation, information content, information delivery channel and information source and will now be discussed.

A. Information Presentation

Information presentation considers the mode with which information is presented, with particular reference to the modality of the information, the tone of the information and the level of simplicity of such information. Each of these points is subsequently

discussed. First, in agreement with the argument by Durant (2002), food safety information can be provided in a textual, verbal, visual or an integrated modality (see section 2.3.2). In consonance with this, Bondarianzadeh et al. (2011) reported that consumers preferred visually attractive pamphlets to re-printed materials. Verbal messages, on the other hand, are more appropriate for high-involvement situations such as when a consumer is actively searching for food safety information such as it is required to prepare a certain recipe. However, verbal information is more difficult to process and typically erodes easily in memory, hence it requires more frequent exposures in order to achieve the intended purpose (Solomon et al., 2009). Therefore, it is clear that each form of information has its merits and demerits, thus drawing attention to an integrated form of information presentation; rather than choosing to focus on one information form (graphics) as implied by Jacob et al. (2010). Since one size does not fit all, it is, however, important to conduct a formative study in order to identify the most appropriate information modality for the target audience.

Second, consistent with the arguments by Tiozzo et al. (2011) and Jacob et al. (2010), the information tone should be simple, clear, efficient and reliable. Findings from an Italian formative investigation revealed that consumers in that region preferred information that is not too serious or anxiety-inducing (Tiozzo et al., 2011). Those consumers indeed appreciated the use of irony, cartoons and pleasing but not too bright colours. Again, this points to the importance of conducting a formative study in order to identify the appropriate information tone for the target audience.

Third, as risk communication takes place in an information-saturated environment where consumers are inundated with a huge number of messages about different issues, food safety messages may be overshadowed or even lost (Bondarianzadeh et al., 2011). Therefore, information overload must be avoided if food safety information interventions are to be effective. Thus, food safety information educators and researchers should identify the optimal amount of information for the target audience.

B. Information Content

While most information requirements can be easily determined through the stipulated industry regulated guidelines, it is recommended that safe food handling information interventions should be based on best practice guidelines. However, this may not be possible for every country as evidence reveals that Ireland (Brennan et al., 2007) has a

set of food safety best practice guidelines for consumers while Australia does not have such guidelines for consumers (ANZFA, 2001). This argument is in agreement with section 2.3.4 which concerns differences across nations. Therefore, food safety information educators should examine the available standards, guidelines and regulations within the target country before drawing on standards and practices that are international in scope. Table 2-4 shows a summary of different types of food information that may be of interest to consumers.

Table 2-4: A summary of food-related information for consumers

Context	Food-related Information Contents					
	Generic Information		Food Quality Information		Food Information	Safety
Information Content	Label Information (Use-by, Best-before dates, brand)	Nesbitt et al. (2014), Grunert et al. (2014), Shim et al. (2011), Ortega et al. (2011), de Krom and Mol (2010), Behrens et al. (2010)	Nutrition Information	Grunert et al. (2014), Wang et al. (2013), Tobin et al. (2012), Shim et al. (2011), Pieniak et al. (2013), Ortega et al. (2011), de Krom and Mol (2010), Behrens et al. (2010)	Safe food handling / kitchen practices	Stenger et al. (2014), Losasso et al. (2012), Bearth et al. (2014b), Al-Sakkaf (2012), Gilbert et al. (2007), Brennan et al. (2007)
	Storage Information		Health benefits			
	Cooking Information		Country of origin Information			
	Allergy Information		Certification labels/logo			
	Contents or Ingredients		Environmental Impact			
	Portion Information		Ethical Impact			

C. Information Delivery Channels

Consistent with Kuttschreuter et al. (2014), the categories of available information channels are traditional media, web-based media as well as mobile and social media. The choice of using any of these information channels for food safety information intervention should involve the consideration of many factors, especially the factors that are unique to the target audience. For example; Wu et al. (2013) argued that the use of mass media is probably not appropriate in China while Nesbitt et al. (2014) indicated the increasing shift towards the use of internet and social media for food safety education in Canada. However, there is evidence that only social media may be suitable for young

adults in the United States (Mayer and Harrison, 2012). Therefore, the proper choice of the information channel to each consumer segment within the target audience is important. Consequently, there is a need to conduct a formative study in order to identify the appropriate combination of information channels for the target audience (see section 2.3.4). Table 2-5 shows a summary of information delivery channels.

Table 2-5: A Summary of information delivery channels

Context	Information Delivery Channels					
	Traditional Media		Web-based Media		Mobile and Social Media	
Information Channels	Television	Bondarianzadeh et al. (2011),	News websites	Bearth et al. (2014b),	Micro blogs: Twitter	Mayer and Harrison
	Radio	Brennan et al. (2007),	Search engines	Jacob et al. (2010),	Online forums	(2012),
	Cooking books	Jacob et al. (2010), Liu et al. (2014),	Food agency websites	Kuttschreuter et al. (2014),	Online videos: YouTube	Kuttschreuter et al. (2014),
	Self-experienced courses	Mateus et al. (2014),	Consumer association websites	Nesbitt et al. (2014),	Smartphone Apps	Bearth et al. (2014b),
	Words of mouth (friends and family)	Nesbitt et al. (2014),		Taché and Carpentier (2014),	Social networks: Facebook, Google+, Myspace	, Nesbitt et al. (2014)
		Ovca and Jevšnik (2009),		Shim et al. (2011),		
	Posters	Shim et al. (2011),		McMeekin et al. (2006), Liu et al. (2013),		
	Labels	Stenger et al. (2014),		Mayer and Harrison (2012)		
	Brochures	Taché and Carpentier (2014),				
	Retailers	Pieniak et al. (2013),				
	Pamphlets	Parra et al. (2014)				
	Newspaper					
	Magazine					

D. Information Sources

Based on findings in the literature, there are many sources of food safety information. However, for some groups of consumers, food safety information from some sources is not trusted. Evidence reveals that some consumers prefer safety labels authorised by the government while others prefer those authorised by private organisations (Van Loo et al., 2014, Ortega et al., 2011). Thus, food safety information educators should identify the appropriate and trusted source of information for each consumer cluster within the target audience. Table 2-6 below shows a summary of food-related information sources.

Table 2-6: A summary of food-related information sources

Context	Organisation-based Sources		Research-based sources		Personal Sources	
Information Sources	Government agencies	Tiozzo et al. (2011), de Krom and Mol (2010), Liu et al. (2014), Pieniak et al. (2013), Wang et al. (2013), Ergönül (2013), Nesbitt et al. (2014)	Academics	Liu et al. (2014), Mateus et al. (2014), Ovca et al. (2014), Pieniak et al. (2013), Wang et al. (2013), Ergönül (2013)	Health professionals	Bondarianza deh et al. (2011), Liu et al. (2014), Mateus et al. (2014), Ovca et al. (2014), Verbeke and De Bourdeaudh uij (2007), Wansink et al. (2014), Ergönül (2013), Nesbitt et al. (2014)
	Consumer protection associations		Scientific journals		Nutritionists	
	Non-government food agencies		Scientific reports		Parents, relatives and friends	
	Producer and retailer groups		Teachers			
	Institutional campaigns		University			

Therefore, these findings have provided directions on considerations for food safety information interventions. In summary, investigating interventions aimed at enhancing consumer food safety and management behaviour requires more research effort on consumers' post-purchase behaviour within a situated context. Also, drawing on habit-driven strategies and risk communication strategies, evidence suggests that only limited studies from the Information Systems perspective have investigated the role of information technology on consumer safe food management behaviour. Thus, there is a need to investigate the use of IT and its complexities (information presentation, information delivery channels, information content and information sources) on consumers' food management behaviours.

2.3.7 Critical Reflections on Section 2.3

This section has presented an overview of the literature relating to consumer behaviour as related to the research context. It started by providing an introduction to consumer behaviour and progressed by discussing communication from an information modality perspective. Following this, it has presented a review of the peculiarities of consumer food information processing which led to the discussion of consumer food behaviour. Consequently, risk communication and ICT was discussed in terms of information presentation, information content, information delivery channels and information sources while concluding with a critical reflection on the section. The findings within

this section have identified the following key points and gaps in the existing body of literature;

- An assessment of Macinnis' (2004) consumer behaviour framework reveals that a large part of the decision making process depends on the information and knowledge available to the consumer. Though numerous research have been conducted on the impact of diverse information modalities on consumer knowledge, yet it is still unclear how the acquired knowledge can be translated to corresponding behaviour.
- This research has uncovered a gap in our knowledge on consumer understanding, knowledge retention and the corresponding translation into behaviour of safe food handling and management which may well be a medium to high involvement task; thus requiring investigation.
- It is imperative to investigate the norms, attitude and behaviour of the target audience (consumers) in relation to food but more specifically food handling and management practices.
- There is a need to investigate the influence and use of ICTs and its complexities (information presentation, information delivery channels, information content and information sources) on consumers' food management knowledge retention and behaviours.

2.4 Food Safety: An IT Perspective

This presents an overview of the literature relating to food safety from an IT perspective. It discusses food safety with an IT lens in terms of presenting introductory information about food chains, explaining food safety while ensuring a distinction between food safety and food quality. In addition, it discusses the regulatory solutions to food safety issues, presents recent research on safe food management from an IT perspective while concluding with a critical reflection. It is however important to note here that the aim of this review is not to critique food safety research but rather to review, summarise and identify gaps in the domain where information systems might be suitable to improve, enhance or mitigate problems.

2.4.1 An Introduction to the Food Chain

The food supply chain is characterised by the transformation of raw materials to products that can be easily bought, prepared and consumed through the movement of food from the farm to the consumer. Food procurement and manufacturing companies, wholesale and distribution firms, brokers, food service firms, restaurants and retail grocery firms are all embedded within this chain (King and Phumpiu, 1996). This chain is also known for large volume and variety of products. Besides these characteristics, the Table 2-7 shows a more detailed view of the peculiarities of the food chain based on evidence from the literature.

Table 2-7: Peculiarities of the Food Chain

Source: Author based on evidence from the literature

Issues	Factors influencing the food chain; thus making it unique		
Participatory level	Growers	Manufacturers	Consumers
	Hazardous weather (Fredriksson and Liljestrand, 2015)	Continuous quest to accurately assess demand (Lütke Entrup, 2005, Shukla and Jharkharia, 2013).	Require more information about the sources of the products and its contents (Price et al., 2016, Reid and Rout, 2016).
	Increase in input costs (Acharya et al., 2009)	Synchronization of plans with retailers (Fredriksson and Liljestrand, 2015).	Changing dietary requirements (Dubowitz et al., 2015, Cummins et al., 2014)
	Uncertainties in demand (Fredriksson and Liljestrand, 2015)		
	Volatile market prices (Gilbert, 2010, Prakash and l'agriculture, 2011)		
Food Safety	Adhering to regulatory requirements for growers, manufacturers and retailers (Ryan et al., 2010, Henson, 2008)		Domestic food handling and management (Kosa et al., 2015, Sneed et al., 2015, Donelan et al., 2016)
Food Security and sustainability issues	Climate change, food wastage, change in consumer patterns, contamination and recalls, water sources, population growth, and the volume of energy consumption by the food industry (Hamprecht et al., 2005, Vasileiou and		

Part of the major issues facing the food industry today, concerns food quality and safety. These issues have led to awful food crises such as bovine spongiform encephalopathy (BSE) (Kelepouris et al., 2007), dioxin (Beulens et al., 2005), classic swine fever, foot and mouth disease (van Dorp, 2003, van Rijswijk et al., 2008) causing a global attraction of attention. This is because of the huge impact on the physical health of the consumers, as well as the wellbeing of businesses within the industry (Jansen-Vullers et al., 2003). As the production and consumption of food is inevitable for any society, it becomes imperative to consider the health-related, social and economic influences of these concerns.

2.4.1.1 Health-related Outcomes

Food safety is still a global source of concern based on its potential to cause significant foodborne sicknesses, and in some cases deaths, due to the inadequacies of one or more actors of the supply chain – farmers, manufacturers, retailers and consumers (Lazou et al., 2012, Gong et al., 2016, Bai et al., 2014). Based on the unavailability of reliable data, it is difficult to estimate the global incidence but it has been reported that about 550 million persons fall ill out of which 230,000 die annually due to food borne diseases (WHO, 2015). As many of these cases are sporadic and are due to small outbreaks originating from the home (Lazou et al., 2012), this does not only highlight that these cases are largely underestimated and underreported (EFSA, 2012, WHO, 2015) but also underscores the fact that the consumer is a fundamental component of the food chain (Hassan and Dimassi, 2014). Therefore, for regulatory efforts to be effective, it must incorporate safe food management and handling practices such as safe food purchase, transportation, storage and preparation within the home environment (Kennedy et al., 2005, Hassan and Dimassi, 2014).

2.4.1.2 Social Outcomes

Due to the concerns associated with the health-related outcomes (see section 2.4.1.1) and economic outcomes (see section 2.4.1.3), government agencies and the food industry as a whole have been involved with building capacity in order to ensure food safety which also empowers the social and political security of a nation (Bosona and Gebresenbet, 2013).

On the other hand, consumers are more interested in knowing more about the provenance, quality and safety of their food and this has contributed to the shift from quantity to quality and safety oriented agriculture (Salampasis et al., 2012). Such shifts are largely due to changing lifestyles, increase in income of consumers, increase in awareness of health and weight control (Kimura et al., 2008) and the fear of illnesses and death through food borne diseases; thus making them desire fresh, palatable, nutritious and more importantly, safe food (Bosona and Gebresenbet, 2013).

2.4.1.3 Economic Outcomes

Food related illnesses do not only have their influences on the consumers' health, it also affects the food industry and the economy at large (WHO, 2002). Once consumers are affected, health-care systems become involved and ultimately the economic productivity becomes affected (Aung and Chang, 2014).

In the United States, the Centre for Disease Control and Prevention estimated that about 48 million people (1 in 6) are affected by foodborne diseases (CDC, 2011) which costs about \$77.7 billion annually (Scharff, 2012). In New Zealand, about 3241 per 100 000 population are annually affected which costs a total of NZ\$55.1 million annually, while NZ\$48.1 million is the cost for loss of productivity (Scott et al., 2000). In Australia, it is estimated that about 5.4 million people are affected, which costs about AU\$1.2 billion annually (Hall et al., 2005, AIHW, 2011).

Therefore, this reveals that public health issues such as food poisoning or foodborne diseases, due to food safety lapses that occurred somewhere along the supply chain and/or within the regulatory system or even in the consumer home, could have grave consequences.

2.4.2 Food Safety

As defined by the CAC (2003a), food safety is the “*assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use*”. It concerns all forms of hazards that can make food injurious to the consumer's health. This is a global concern and it has affected the health of many people globally. Thus, it involves a collective responsibility by all members of a supply chain, including the consumers (Aung and Chang, 2014). Food quality on the other hand could be relative, from consumer to consumer, as different people have different expectations. However,

food safety is recognized as an attribute of food quality (Pinto et al., 2006, Röhr et al., 2005) since a product can appear to have a high quality whereas it may be unsafe as it may be contaminated with toxic chemicals or physical hazards amongst other contaminants (UN, 2007).

Food quality is a heterogeneous construct with different meanings to various categories of people, such as consumers, engineers, food technologists and others. It is widely accepted that the quality construct has an objective and a subjective dimension as engineers and food technologists deal with the physical properties built into the product thus having an objective view, while consumers hold onto the subjective view (Grunert, 2005). Hence, it is important to know that consumers typically form individual perceptions on food quality (Röhr et al., 2005). According to Cardello (1995), food quality is a “consumer-based perceptual/evaluative construct that is relative to person, place and time and that is subject to the same influences of context and expectations as are other perceptual/evaluative phenomena”.

Research has indeed highlighted the differences between expert and consumer perceptions of optimal food safety (Krystallis et al., 2007, Houghton et al., 2008) as well as those concerning optimal food quality (Grunert et al., 2006). However, as advised by van Rijswijk and Frewer (2008) and in order to be more relevant to the consumers actual needs, the perception of consumers on food quality is drawn upon.

With a focus on food safety, it is believed that consumers usually imply that any food on the shelf is intrinsically safe; thus taking food safety for granted (Tsakiridou et al., 2011). However, since safety is non-negotiable, a consumer, under normal circumstances, would not purchase or consume an unsafe food. Despite the fact that consumers do not seem to be worried about food safety under normal circumstances, the occurrence of a food safety incident usually has unpalatable consequences for the parties involved (Verbeke et al., 2007).

Therefore, food safety is seen as an important dimension for growers, manufacturers, food businesses and consumers. However, as consumers tend to believe that any food on the shelf is intrinsically safe, there is a tendency for them to rely on supply chain actors for ensuring the safety of the product, thus absolving themselves of any safe food handling responsibility.

2.4.3 Regulatory Solutions to Food Safety Issues

Mitigating food safety risks is a major source of concern for government authorities, the food industry and other stakeholders. Diverse innovative mechanisms focused on monitoring and controlling production processes across supply chains, such as ISO22000 (Varzakas and Arvanitoyannis, 2008), HACCP control systems (Unnevehr and Jensen, 1999), HARPC control systems (Grover et al., 2016), traceability systems (Regattieri et al., 2007), have been employed to address many of these risks. Some of these regulatory solutions will now be discussed.

2.4.3.1 HACCP

Hazard Analysis Critical Control Point (HACCP) is a structured approach to identifying, assessing risk and controlling hazards associated with the production process of food (Varzakas and Arvanitoyannis, 2008). HACCP is preventative as it addresses the causes of food safety problems within processes such as production, storage and transportation across the supply chain (FDA, 1994). Thus, it aims to identify potential problems before they occur by establishing control mechanisms at critical stages of food production that are relevant to the safety of the product. According to HACCP (2011) and FAO (2001), the seven principles of the HACCP approach in all aspects of food production and processing are as follows;

1. Conduct a hazard analysis.
2. Determine the Critical Control Points (CCPs).
3. Establish critical limit(s).
4. Establish a system to monitor control of the CCP.
5. Establish the corrective action to be taken when monitoring indicates that a particular CCP is not under control.
6. Establish producers for verification to confirm that the HACCP system is working effectively.
7. Establish documentation concerning all procedures and records appropriate to these principles and their application.

Therefore, it is indeed clear that this safety mechanism focuses on supply chain partners and their processes whilst having no impact on the safe food handling processes of food consumers.

2.4.3.2 ISO22000

The International Organisation for Standardization (ISO) defined the aims of the standard ISO22000 ‘Food safety management systems – Requirements for food chain organisations’ as the worldwide proper implementation of the internationally well-known principles of HACCP from the food chain organisations to provide safe food to the consumers (Varzakas and Arvanitoyannis, 2008). The ISO22000 creates a uniform platform of requirements for a food safety management system that are acceptable to all authorities globally. These requirements comprise of all food organisations involved in the food chain from farmers to catering businesses (Varzakas, 2011). According to Varzakas and Arvanitoyannis (2008), the advantages of the ISO22000 standard includes the following;

1. Optimum distribution of resources inside the food chain organisation.
2. Effective communication of suppliers, clients, authorities and other involved authorities. Focus on the prerequisite programmes, conditions and hygiene measures, planning of preventive actions with the aim to eliminate any possible failures.
3. Better documentation.
4. Creation of trust based on the provision of the conditions for the accomplishment of solid results.

Therefore, it is again clear that this safety mechanism focuses on supply chain partners and their processes whilst having no impact on the safe food handling processes of food consumers.

2.4.3.3 Food Traceability: An IT Perspective

Due to food safety concerns, food traceability has become an important phenomenon. The International Organisation for Standardization (ISO) defined traceability in 1994 as “the ability to trace the history, application or location of an entity by means of recorded identifications” (ISO, 1994) but later amended it to “the ability to follow the movement of a feed or food through a specified stage(s) of production, processing and distribution” (ISO-22005:2007, 2007). However, Olsen and Aschan (2010) believe that the initial ISO definition is the most accurate when considering product traceability because of the emphasis laid on “*by means of recorded identifications*”. Since information sharing is however the major concern here (see Figure 2-3), it seems more appropriate to consider

the definition of Bosona and Gebresenbet (2013). Moreover, Aung and Chang (2014) asserts that it is a much more comprehensive definition.

*“Food traceability is part of logistics management that capture, store, and transmit **adequate information** about a food, feed, food-producing animal or substance at all stages in the food supply chain so that the product can be checked for safety and quality control, traced upward, and tracked downward at any time required” (Bosona and Gebresenbet, 2013).*

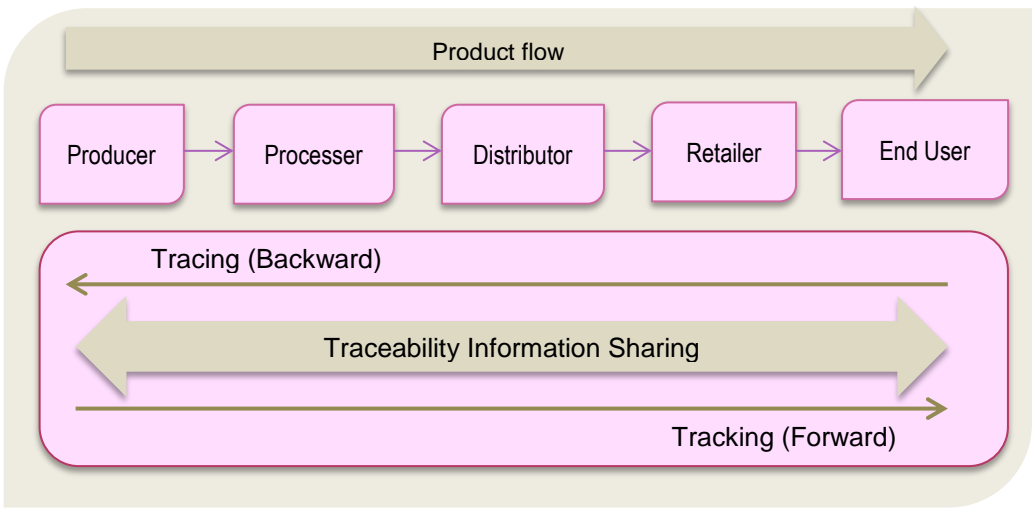


Figure 2-3: Traceability: An Information sharing Perspective

Source: Bosona and Gebresenbet (2013)

Food supply chain traceability has to manage technical, managerial and environmental issues which are critical to its survival. The technical issues include but are not limited to internet and web technologies, sensing technologies, location technologies, identification technologies such as barcode, RFID amongst others. The environmental issues include the protection of odours, pollutants, contaminants, waste and water management and others while the managerial issues include traceability data management, the implementation of coordination amidst supply chain partners (SCP) as well as transparency, authenticity and access of information (Aung and Chang, 2014). As this research focuses on the IT perspective, the Table 2-8 below gives a detailed overview of the technical challenges being faced.

Table 2-8: Detailed overview of the technical issues in traceability technology

Source: Aung and Chang (2014)

Technology	Description	Advantages	Challenges
Alphanumeric Codes	This is a label containing a sequence of numbers and letters in diverse sizes but has been replaced by barcodes.	It is simple to use and cost effective.	Lacks sensing capability. No standards defined. Poor data integrity. Poor performance. Code read/write is not automatic.
Barcodes	This is an optical machine readable representation of data which encodes alphanumeric character and comprises of vertical bars, spaces, dots and squares.	It is simple and more cost effective.	It requires line of sight. Damaged labels become unreadable. Lacks sensing capability. Time consuming.
Radio Frequency Identification (RFID)	It identifies tagged objects using radio waves.	It does not require line of sight in reading tags. It has the ability to read and write tags. It saves time by reading many tags simultaneously. It has a higher data rate and a larger memory size.	Limited sensing capability. Inability of tags to initiate communication, hence it has to rely on the reader for data collection. Still not cost effective. Lack of cooperation among the devices. It has the ability to read data within one hop only.
Wireless Sensor Networks (WSN)	It has the ability to collect sensing data from diverse physical and environmental conditions through sensors which are available for sensing and monitoring.	It has longer reading ranges. It allows secure communication between nodes. It can also deploy different network topologies	It requires energy saving solutions for continuous sensing. It is not suitable for the purpose of identification.

While these useful technologies indeed have their own challenges, they have certainly been helpful as traceability instruments. However, **cost** is one the factors hindering supply chains from adopting and implementing a chain-wide integrated traceability information system. Another problem hindering the adoption and implementation of such systems has to do with **transparency** among supply chain actors as there is a need to maintain a balance between useful transparency and the confidentiality of information among the actors (Thakur and Donnelly, 2010). Another problem is the issue of **paper-based systems** (Bechini et al., 2005) which are still in use in firms within some supply chains, this makes integration of information difficult. This shows that before a supply chain can take advantage of the benefits of any or all of the instruments highlighted above, there are indeed some pre-requisites for traceability.

In summary, the concern with these regulatory solutions to food safety issues, such as RFID technology for traceability, is that most of them are largely focused on supply chain activities from ‘*paddock-to-purchase*’ (pre-purchase) as the legal obligations of supply chain partners on food safety tends to be completed once consumers purchase the products (Bamgboje-Ayodele et al., 2016). Thus, mitigating food safety risks during the process of consumption (post-purchase), which entails domestic food management and handling from the point of purchase (*purchase*) to the point of actual consumption (*plate*), is largely the responsibility of consumers.

In addition, with recent pervasiveness of ICT (see section 2.2.1), in consumer food handling, the use of RFID technology is no longer limited to ‘*paddock-to purchase*’ as it is now mainly used in smart microwaves and smart fridges to help consumers in *shopping* such as the creation of grocery list (Spasova et al., 2009), *thawing* such as commencing defrosting remotely (Luo et al., 2008), *preparation* such as weekly meal design and *storage* such as automatic reminders of foods going bad in the fridge (Luo et al., 2009). With this in mind, it becomes imperative for consumers to learn basic safe food handling practices as these smart devices handle different points in the purchase-to-plate process in silos and do not guarantee that the food on the plate is completely safe to eat. For example: a consumer must know when and how long to commence remote defrosting when using a smart microwave; and a consumer must know how to ensure proper kitchen hygiene such as handwashing when preparing meals designed by a smart fridge and/or smart microwave. Therefore, as the pervasiveness of ICT in the kitchen, does not preclude unsafe food handling practices, domestic safe food management knowledge becomes a very important necessity for consumers.

2.4.4 Safe Food Management: A Consumer Perspective

Based on a review of research conducted within this space, consumer food-related activities and behaviour such as the pre-determined decisions before going to the point of purchase, decision influencers at the point of purchase, actual purchase, food handling, actual consumption and disposal have been considered to varying degrees. While some of these activities and behaviours were considered individually, cross-cutting issues which spanned across various consumer food-related activities and behaviour were discovered (see Appendix A).

The cross-cutting issues on consumer food behaviour include: consumer behaviour on safe food management; cultural predisposition of consumers influencing food purchase and handling; education on safe food handling; environmental issues influencing food purchase; legislative issues on food handling; risk perception and risk communication issues; food safety perceptions and knowledge; and the use of information technology for food-related information sharing.

2.4.4.1 Consumer Behaviour on Safe Food Management

Within this sub-section, there are a number of studies that have investigated consumer behaviours in relation to safe food *purchase*, *handling* and *consumption*. Concerning safe food *purchase*, a study in Brazil reported consumers' preference for supermarkets over street markets, for the variety of foods, convenience and confidence in the safety assurance but observed lack of awareness regarding potential risky behaviours (Behrens et al., 2010). In a study considering consumers' attitude towards shelf-life labels and dates, it was revealed that consumers in Belgium had a sub-optimal understanding and therefore interpreted shelf-life labels and dates with flexibility, with variation depending upon the type of food product under consideration (Van Boxstael et al., 2014). A similar study which evaluated Chinese consumers' decision-making processes in relation to safe food revealed that consumers have a low recognition of the relevant labels and a limited ability to identify safe food (Liu et al., 2013). In the United States, a study which compared consumers attitude and actual behaviour realized that many consumers think the food country of origin label (COOL) is extremely important, but they do not check the label when purchasing (Wang et al., 2013).

A very interesting study was conducted by Losasso et al. (2012) whose aim was to change the food *handling* behaviour of some Italian consumers. Using an educational approach, they suggested that the habit-driven strategies were indeed successful in changing the behaviour of some of the consumers. However, daily adequacy of meal item which is a health habit item was measured before (67.1%) and after the intervention (66.7%) and it resulted in 0.916 as the p-value. This suggests that knowledge and awareness was improved in other outcomes measures, but not necessarily behaviour. Perhaps, this may be due to the methodology incorporated within the research to determine the effectiveness of the intervention. Hence, while habit-driven strategies may be helpful, their application in food safety and management interventions is important.

Furthermore, an immediate replication of information in short-term does not necessarily imply a long-term retention of knowledge. This argument can be buttressed by findings from a review by Taché and Carpentier (2014) who argued that being aware of food-related risks is not sufficient to incite individuals to apply good hygiene practices. An empirical evidence supporting this argument revealed that most Japanese consumers did not discriminate between their attitudes toward the consumption of the two types of cloned beef (specifically, beef derived from bovine embryo and somatic cell-cloned cattle), and that most respondents did not change their attitudes toward cloned beef after receiving technological information on animal cloning (Aizaki et al., 2011). The information the authors provided to the Japanese participants included four components: an explanation of nuclear transfer; an explanation of bovine embryo and somatic cell cloning processes; an explanation of the relationship between donors and their cloned calves, and among cloned calves; and a discussion of the expected merits of animal cloning. They finally concluded that the provision of technological information about animal cloning did not influence the respondents' attitudes toward the consumption of the two types of cloned beef.

In relation to safe food *consumption* behaviour, a study investigating consumers' willingness to eat hamburgers, reported that emotions play an important role in the likelihood of eating risky food (Olsen et al., 2014). Another study, which investigated the dietary behaviour and the perceived role of food for health of pregnant versus non-pregnant women, revealed that the observed differences in dietary behaviour can be attributed to the state of being pregnant (Verbeke and De Bourdeaudhuij, 2007). In a study investigating the reasons why consumers in Ireland deviated from best-practice guidelines concerning safe food, it was revealed that the factors responsible were personal (overconfidence, lack of interest), environmental (technological) and lifestyle (time and energy investment) (Brennan et al., 2007).

Therefore, in consonance with the arguments by Smith and Riethmuller (1999), Mateus et al. (2014), these findings suggest that consumer behaviours on food related issues are indeed influenced by many factors such as cultural, socio-economic, environmental and psychological. These factors have an impact on how consumers receive and utilise food-related information that is presented to them. Thus, one of the challenges that make the research problem in this thesis complex is the need to investigate the factors affecting

the safe food management behaviour of the consumers concerned before developing any information campaign or awareness program.

2.4.4.2 Cultural Predisposition of Consumers Influencing Food Purchase and Handling

This review also reveals that a limited number of studies have investigated consumers' cultural predisposition in relation to safe food handling. Cultural predisposition can be defined as stable individual-level traits that determine the acceptance or rejection of the information received (Achterberg, 2014). A study that demonstrates the influence of cultural predisposition investigated food safety knowledge (see section 2.1.1.2 for the definition of knowledge), beliefs and practices among Hispanics in the USA, and the findings indicate that Hispanics place decision-making authority in their elders (Stenger et al., 2014). Consequently, it was argued that Hispanic grandmothers could be utilised as nutrition educators to incorporate culture-specific food safety messaging. In this context, beliefs are developed through memberships in various social groups and are defined as ideas and thoughts about oneself, the world and one's position in it (Cross, 2009). On the other hand, practices are defined as the skills, tacit knowledge and presuppositions that underpin activities (Swidler, 2001).

Drawing on social practice theory, a study concerning consumers' existing shopping practices in Vietnam reported that within the everyday practice of shopping for vegetables in wet markets, consumers reproduce long-established and culturally embedded relations of trust (Wertheim-Heck et al., 2014). Therefore, consumers do not easily move beyond their existing routines, even when food safety concerns would urge them to do so. In consonance with this, de Krom and Mol (2010) reported that consumer trust in food is constituted and reproduced in situated practices of buying food, thus arguing that the interplay of consumer predispositions, pleasant physical settings in shops and good relations with food system actors constitute trust.

Therefore, these findings suggest that, as the culture of different groups of people varies, the food safety intervention programs targeting diverse groups of people should vary. As a result, it is recommended that food safety information educators should understand the prevailing culture within their target audience so as to provide insights into the development of information or awareness programs.

2.4.4.3 Education on Safe Food Handling

According to the review conducted, a number of studies have investigated consumers' level of awareness and knowledge in relation to safe food handling. In a study investigating the level of awareness of Turkish consumers in terms of food safety, food handling, storage and cooking, Ergönül (2013) reported that there was sub-optimal knowledge and therefore argued for much more consumer education based on government publications and through the mass media. However, the findings of the study also indicated that educating consumers require the use of appropriate information channels as well as the appropriate information source. In consonance with this, Wu et al. (2013) argued that the information source and the way the information is framed are important when educating consumers about food safety. Based on results of a study conducted in China, Wu et al. (2013) argued that the use of mass media is probably not appropriate since reporters do not have food safety expertise and inaccurate information could be worsened through poor journalism. While the study on Turkish consumers (Ergönül, 2013) favoured the use of mass media, the study on Chinese consumers (Wu et al., 2013) showed the limitation of the use of mass media and a similar study in Canada (Nesbitt et al., 2014) indicated the increasing shift towards the use of internet and social media for food safety education.

Therefore, the findings suggest that educating consumers does not only involve delivering the appropriate content to the target audience, it also involves utilising the appropriate information channels as well as trusted sources of food safety information which is, again, dependent on the target audience. Thus, it is recommended that food safety information educators should conduct a formative investigation, in order to identify the appropriate information channels as well as the appropriate information source for the target audience.

2.4.4.4 Environmental Issues Influencing Food Purchase

In this sub-section, the review conducted revealed that limited studies have investigated consumers' perception on sustainability issues at a general level when considering consumer decision-making. In a study investigating the relationship between consumer motivation, understanding and use of sustainability labels on food products, Grunert et al. (2014) reported consumers' medium high to high levels of concern with sustainability issues. These consumers were from the UK, France, Germany, Spain, Sweden, and

Poland. However, it was interestingly noted that sustainability labels do not play a major role in consumer food choices as general concern about sustainability did not translate into actual behaviour. This is in consonance with findings from the studies conducted by Taché and Carpentier (2014) and Aizaki et al. (2011), as discussed in section 2.1.4.1 above, that being informed about food safety and/or sustainability issues does not necessarily translate into corresponding behaviour.

In another study, which compared consumer preferences for four types of sustainability claims (organic meat, free range, animal welfare and carbon footprint) Van Loo et al. (2014) reported that nine in every ten Belgian consumers favoured free range claims (thus attracting high premiums). However, carbon footprint labels and the organic labels were less appealing to consumers, who had lower willingness to pay more for these labels. When considering the information source, it was revealed that Belgian consumers (Van Loo et al., 2014) indeed preferred sustainability logos that were certified by private organisations, to the ones certified by government organisations. This supports the argument in section 2.1.4.3 that the use of an appropriate information source is important.

Therefore, while the findings substantiate the recommendation in section 2.1.4.3 about conducting a formative investigation, it also highlights the argument in section 2.1.4.1 that being informed does not necessarily translate into behavioural change. However, providing the right information, from a trusted information source through the right information channel, to the target audience puts consumers in a better position to be able to make more informed decisions.

2.4.4.5 Legislative Issues on Food Handling

Findings from the review revealed that limited studies have investigated consumers' perception and the efficacy of existing food safety policies on food handlers. In order to support the implementation of the U.S. Food Safety Modernization Act (FSMA), a study in Pennsylvania, USA, revealed that consumers do not believe that the existing policies and practices of stakeholder groups provide sufficient protection from foodborne contamination (Tobin et al., 2012). The situation is, however, worse in Port-au-Prince, Haiti, as Samapundo et al. (2014) reported, that the conditions in which street food vendors operate are largely unacceptable from a food safety point of view, due to lack of food safety legislation.

In addition, another study by Ortega et al. (2011) indicated that food ingredient labelling policy is not yet mandated in China. Therefore, information that is voluntarily provided by some producers is usually not trusted, as Chinese consumers rely on verification of safety information by the government. This also supports the argument in sections 2.1.4.3 and 2.1.4.4 that the use of the appropriate information source is important.

Therefore, it is recommended that food safety information educators should understand the food safety policies and laws which are in place within the locality of the target audience before developing any information or awareness program.

2.4.4.6 Risk Perception and Risk Communication Issues

Here, a number of studies that have investigated consumer risk perception and issues regarding food risk communication are considered. Concerning consumer risk perception, a USA-based study revealed that consumers with fear of a specific ingredient, such as high-fructose corn syrup, may exaggerate and overweigh perceived risks (Wansink et al., 2014). A different study indicated that Mexican-Americans born in the U.S. and those of Mexican origin living in the U.S. differed in their level of risk awareness and in their compliance with some associated food safety practices (Parra et al., 2014). Also, a similar study on 10-to-12 year olds in Slovenia indicated that a high level of perceived severity and a low level of perceived vulnerability concerning food-related risks were observed (Ovca et al., 2014).

In order to support the development of control strategies using the framework of quantitative microbial risk assessment (QMRA) models, Migliorati et al. (2013) measured the actual exposure of consumers in central Italy to pathogenic microorganisms. Their findings revealed that the consumers generally proved to be quite cautious with respect to the degree of cooking, with positive implications for their actual exposure to foodborne thermo-labile microorganisms. Another study, which aimed at supporting the SAFE FOOD framework, revealed that the available approaches of assessing social impacts pose some challenges while trying to incorporate it into the framework (Cope et al., 2010b).

In a study measuring Chinese consumer preferences and food safety risk perceptions, for select food safety attributes in pork, Ortega et al. (2011) reported that food safety risk concerns significantly affect consumer welfare and willingness to pay (WTP) for food

safety information. They revealed that Chinese consumers have the highest WTP for a government certification program, followed by third-party certification, a traceability system, and a product-specific information label respectively. In a similar study identifying consumer perceptions of risk and trust in information sources, Liu et al. (2014) reported that Chinese consumers were mostly worried and knowledgeable and they worried about poor-quality food. They also found that the most popular information channels were television, the internet and personal communication, while the most trusted information sources for food safety information were medical doctors, personal experiences and research institutes. This also points to the arguments in sections 2.1.4.3, 2.1.4.4 and 2.1.4.5 that different groups of consumers are influenced by certain information sources and information channels. Thus, it highlights the need for utilising the appropriate information source when food safety issues are being communicated with consumers.

With reference to studies focused on food safety risk communication, Wu et al. (2013) found that timely release of food safety information by the government, curbing misleading media reports on public food safety risk, and optimising consumer knowledge of food additives are quite important when communicating food risks. In a similar study examining how print news sources conveyed messages regarding the 2010 Iowa egg recall, Laestadius et al. (2012) suggested that the way the news media framed the recall information, influenced consumer responses to the incident. Therefore, Laestadius et al. (2012) did draw more attention to the use of thematic framing rather than episodic framing, as defined in communications theory when communicating food safety risk information to consumers (Hart, 2010, Gross, 2008). In consonance, Tiozzo et al. (2011) argued that, based on findings of their study on food safety risk intervention, adhering to the principles of communication theory is important for the success of initiatives aimed at communicating health risks.

Thus, these findings recommend that food safety risk communication should be targeted to the appropriate audience with respect to their level of vulnerability and other characteristics. It also highlights that the medium through which information is presented as well as the framing of such information is important. More succinctly, Cope et al. (2010a) recommended risk communication strategies that avoid information

overload and ensure information accuracy, information balance, transparency and consistency while targeting the audience.

2.4.4.7 Food Safety Perceptions and Knowledge

Numerous studies have investigated consumers' food safety knowledge, and reaction to safety issues. In a study examining the maintenance and understanding of cold chain among consumers in Slovenia, Ovca and Jevšnik (2009) found that the term "cold chain" was not well known and consumers thought they were not responsible for maintaining a cold chain. Also, based on a review, Al-Sakkaf (2012) reported that the New Zealanders' knowledge of basic food hygiene is lower in comparison to people of other developed countries. Another New Zealand-based study revealed that there was a potential for consumers to undercook meat products and that consumers behaved in a manner that could cause cross-contamination (Gilbert et al., 2007). In Australia, Bondarianzadeh et al. (2011) found that midwives, who are meant to educate pregnant women, had only limited scientific knowledge about food-related risks and that they relied on their experiential knowledge and common sense.

Furthermore, another study evaluating food safety knowledge and practices among pregnant women in Portugal found that only a few of the women interviewed had heard about listeriosis and almost half of these did not know about the problems it can cause (Mateus et al., 2014). They however noted that the preferred information sources were the doctors and written information in flyers or in the pregnancy bulletins provided by the government. This also buttresses the argument in the preceding sub-sections about the importance of information sources.

Therefore, the findings suggest that it is imperative for food safety information educators to investigate the information needs, perception and existing knowledge of their target audience. This will provide a better understanding of the actual food safety information gaps that should be delivered to the consumers.

2.4.4.8 The Use of Information Technology for Food-Related Information Sharing

Limited studies have investigated the applicability and use of technology in the dissemination of food safety information to consumers. At a general level, in a review conducted on the role of information systems in food safety management, McMeekin et al. (2006) found that databases are particularly useful for rapid dissemination of

information on foodborne disease outbreaks via websites or list servers on foodborne disease incidents and for traceability purposes.

More recently, a study on South Korean consumers revealed that the consumers preferred leaflets and pamphlets, as food safety information channels, to technology-based mechanisms (Shim et al., 2011). Another study on consumers from the Czech Republic, Germany, Greece, Italy, Portugal, Romania, Sweden and the UK revealed that the internet was identified by consumers in all of the countries as one of the most important sources of information about sea and freshwater fish products (Pieniak et al., 2013). Furthermore, Mayer and Harrison (2012) found that young adults in the state of Georgia, USA, preferred the internet as their source of information, videos as the form of information and social media (You-tube) as the preferred information delivery channel for food safety-related information. However, Kuttischreuter et al. (2014) argued that social media can act as a complementary information channel and that it is not a substitute for traditional or online media.

The main finding here is that, to develop a holistic food safety intervention, it is imperative to: identify the appropriate information delivery channel(s); identify the acceptable source(s) of information to the audience; determine the existing information gaps; and to target the audience. However, it remains unclear how to address the aforementioned key points arising from the findings of this review. Perhaps, one way to address this issue is to identify existing research on the food behaviour and culture of the target audience and to conduct a formative investigation to identify the existing information gaps and the appropriate information delivery channels and information sources for the target audience.

2.4.5 Critical Reflections on Section 2.4

The sub-sections within section 2.1 have presented an overview of the literature relating to food safety from an IT perspective. It has discussed food safety with an IT lens in terms of presenting basic information about food chains, explaining food safety while ensuring a distinction between food safety and food quality, discussing the regulatory solutions to food safety issues and presenting recent research on safe food management from an IT perspective. The findings within this section have identified the following key points and gaps in the existing body of literature;

- Food safety is seen as an important dimension for growers, manufacturers, food businesses and consumers. However, as consumers tend to believe that any food on the shelf is intrinsically safe, there is a tendency for them to rely on supply chain actors for ensuring the safety of the product, thus absolving themselves of any safe food handling responsibility.
- The concern with many of the regulatory solutions to food safety issues is that most of them are largely focused on supply chain activities from ‘*paddock-to-purchase*’ (pre-purchase) as the legal obligations of supply chain partners on food safety tends to be completed once consumers purchase the products (Bamgboje-Ayodele et al., 2016). Thus, mitigating food safety risks during the process of consumption (post-purchase), which entails domestic food management and handling from the point of purchase (*purchase*) to the point of actual consumption (*plate*), is largely the responsibility of consumers.
- To develop a holistic food safety intervention from an IT perspective, it is imperative to: identify existing research on the food behaviour and culture of the target audience and to conduct a formative investigation to identify the existing information gaps and the appropriate information delivery channels and information sources for the target audience.

2.5 Chapter Summary

This chapter has presented a review of the literature that is most relevant to this research investigation. The review discussed four sections which comprises the major aspects of the proposed research, in terms of food safety from an IT perspective, information and communication technologies (ICTs), consumer behaviour and knowledge management. The first section discussed the body of literature that has been reviewed concerning the research context in terms of food safety using an Information Technology (IT) lens while explaining food chains, regulatory solutions to food safety issues and safe food management from a consumer perspective. The second section discussed information and communication technologies (ICTs) in terms of the pervasiveness of ICT, and mobile computing which includes smartphone use and food management as well as smartphone apps and usability, context of use & attributes of end-users in safe food management. The third section discussed consumer behaviour in relation to the context

of this research in terms of an introduction to consumer behaviour, communication from an information modality perspective, consumer and food information processing peculiarities, consumer food behaviour and risk communication & ICTs. The fourth section discussed an introduction to data, information and knowledge and progresses by discussing information management and knowledge management concepts. Following this, it discussed knowledge optimisation as KM based on an individual unit of analysis, by focusing on knowledge acquisition, knowledge retention and knowledge application. The findings of this review have identified the following key points and gaps in the existing body of literature;

- The concern with many of the regulatory solutions to food safety issues is that most of them are largely focused on supply chain activities from ‘*paddock-to-purchase*’ (pre-purchase) as the legal obligations of supply chain partners on food safety tends to be completed once consumers purchase the products (Bamgboje-Ayodele et al., 2016). Thus, mitigating food safety risks during the process of consumption (post-purchase), which entails domestic food management and handling from the point of purchase (*purchase*) to the point of actual consumption (*plate*), is largely the responsibility of consumers.
- To develop a holistic food safety intervention from an IT perspective, it is imperative to: identify the appropriate information delivery channel; identify the appropriate source of information; determine the appropriate information content; determine the categories of consumer clusters; and to target the audience.
- There has been limited focus on the actual use, usability, context of use and attributes of the end-users in relation to each of the different areas in which mobile computing has been incorporated in recent times.
- There is a need for a smartphone app that seamlessly integrates all the different stages of safe food handling while addressing each stage with a focus on safety for Australian consumers.
- There is insufficient evidence that the few existing apps that have attempted to address one, some or all of the different stages of the consumer food handling practices from the point of purchase till actual consumption have been evaluated. The few apps that have however been evaluated are largely focused on the

usability of the app whilst many have failed to unpack the inter-relatedness of usability, context of use and attribute & behaviour of the end-users; all of which are fundamental to the holistic evaluation of such apps.

- This research has uncovered a gap in our knowledge on the consumer understanding, knowledge retention and the corresponding translation into behaviour of safe food handling and management which may well be a medium to high involvement task; thus requiring investigation.
- It is imperative to investigate the norms, attitude and behaviour of the target audience (consumers) in relation to food but more specifically food handling and management practices.
- There is a need to investigate the influence and use of ICTs and its complexities (information presentation, information delivery channels, information content and information sources) on consumers' food management behaviours.
- Whilst this research acknowledges the importance of digital pedagogical frameworks in relation to knowledge acquisition and the relevance of a few of its concepts to this research, it however argues that this research is not submerged within the digital educational research space as it is only tangentially relevant to the context defined for this study.
- Evidence suggests that interventions in Australia that aim to improve consumer domestic food management practices should incorporate an approach that does not only involve the consumers but targets the knowledge to their needs using an end-to-end approach, which involves knowledge on safe shopping, transportation, storage, preparation, and kitchen hygiene within the Australian context.

The next chapter presents the methodology of the research.

CHAPTER THREE

METHODOLOGY

3 METHODOLOGY

3.1 Introduction

This chapter describes the methodology used in this research in order to achieve the aim and objectives of this study. The chapter is divided into the following sections:

- Section 3.2 presents the research philosophy and the underpinning subjective ontology and a pragmatic epistemology approach that supported the research.
- Section 3.3 describes the research strategy. This includes a single case study, a survey, a usability study, and a field experiment which were incorporated into a three-phase data collection strategy. The three-phase data collection strategy spanned all three research phases.
- Section 3.4 describes the three-stage research design. First, the research aims and questions are re-introduced. The **Preliminary Stage, Phase One: Investigating Knowledge Gaps – Firm Perspective** involved a case study approach which explored the role played by a food firm in updating consumers' food safety knowledge during a food recall incident. The **Advanced Stage, Phase One: Investigating Knowledge Gaps – Consumer Perspective** involved exploring safe food management knowledge gaps of consumers. **Phase Two: Design and Development of the Safe Food Management App**, involved the process of the design and development of a smartphone app aimed at addressing consumers' safe food management knowledge gaps identified in phase one. **Phase Three: Implementing and Evaluating the Safe Food Management App** involved the process of implementing and evaluating the smartphone app that was developed in phase two to determine its impact on consumers' knowledge acquisition, knowledge retention and perceived behavioural change.
- Section 3.5 presents the tools and techniques that were used in the three stages of the data collection process that supported the research strategy. The preliminary stage, phase one used semi structured interviews, field notes and document reviews. The advanced stage, phase one and phase three both used survey. Phase two used focus group and survey. This section concludes with the ethics approval for this research
- Section 3.6 describes the data analysis approach for each of the research stages. To achieve the research objectives, thematic analysis with an inductive iterative

approach was used for the qualitative data while descriptive and inferential statistics were used for the quantitative data. This led to the description of the analytical approach.

- Section 3.7 describes the data discussion and interpretation approach used for the research.
- Section 3.8 provides a summary of the chapter.

3.2 Research Philosophy

This section presents the research philosophy and discusses the ontological and epistemological positions of the researcher; as it is imperative for a clear and concise methodology to be identified and followed (Rajasekar et al., 2006). As much as the aims of this research highly influences this research, so do the philosophical assumptions, research context and researcher preferences (Trauth, 2001). The philosophical perception defines the lens through which the research is conducted which in turn affects the type of data collected and the way it was collected and analysed. The philosophical assumption underpinning this research adopts a subjective ontology and a pragmatic epistemology.

3.2.1 Ontology

Ontology refers to the provision of an account of the entities that exist within a domain of reality (Grenon and Smith, 2011). Reality is created through people's interactions and beliefs (Neuman, 2005). Ontology is concerned with the nature of all things (Mason, 1996). The ontology determines how the data collected through a research relates to the world. There are two competing philosophical stances within this paradigm: realist and relativist. A realist is also known as an objectivist while a relativist is a subjectivist. In an ontological context, the question to be asked is this; can the phenomena occur in an objective setting – without human interaction, or does the phenomenon occur only through human actions in creating, acting and interpreting it (Burrell and Morgan, 1979)? A research conducted through the objective approach separates the influence of the researcher from the research as the world can only be seen in one way while the subjective approach immerses the researcher and the research participants in the process as the world differs based on who is viewing it (Orlikowski and Baroudi, 1991). The phenomenon under study is not assumed to be unproblematic and value free, therefore

the researcher is inclined to interpret the interactions and meanings within the phenomenon (Orlikowski and Baroudi, 1991).

Therefore, in order to answer the research questions posed, a subjective ontology has been adopted as it offers the opportunity to discover the different meanings and interpretations given by each participant. In order to understand how different consumers interact with food safety apps, it is the individual's perceptions, actions and meanings behind those actions that the researcher is concerned with. The subjective ontological position also allows the interpretive use of numeric information which has the ability to add valuable insights to the subjective perspective each respondent will offer the researcher. Since the study concerns human behaviour, but more specifically, consumer behaviour, it is thus expected that the truth emanating from this research is circumstantial. As such, the most appropriate ontology for this research is of a subjective nature.

3.2.2 Epistemology

Epistemology is the philosophy of knowledge or how researchers have come to know (Trochim and Donnelly, 2008). It is the assumption about knowledge and the process of acquiring it (Hirschheim and Klein, 1992). This means that epistemology deals with the concept of 'knowing' as a whole. Within this belief, there are two major schools of thought: positivism and interpretivism. The positivist paradigm for this belief shows that the researcher and the subject of enquiry are mutually exclusive of one another while the interpretivist paradigm shows that the researcher and subject of enquiry cannot be separated, which means they have to interrelate with one another.

Despite the fact that the ontological and epistemological positions of a researcher are two different entities, Walsham (1995) has suggested that they do not always illustrate inter-linkages and certain ontological positions do not always lead to a pre-determined epistemology as incorporated in this study. Thus, though the ontological position of this research is subjective, the epistemological position draws on the pragmatism approach. The pragmatism approach is rooted in the works of Pierce, James, Mead and Dewey as highlighted by Azzopardi and Nash (2014). Pragmatism accepts that there are singular and multiple realities which are open to empirical enquiry and adjusts towards solving

practical problems in the “real world” (Creswell and Clark, 2007). Therefore, the pragmatists view the measurable world as an “existential reality” thus making reference to an experiential world with different elements or layers, some objective, some subjective and some a mixture of both (Feilzer, 2010).

Within this epistemological stance, knowledge is viewed as being both constructed and based on the reality of the world we experience and live in (Johnson and Onwuegbuzie, 2004). According to Azzopardi and Nash (2014) citing Creswell et al. (2003), knowledge claims “arise out of action, situations and consequences”. Creswell et al. (2003) has argued for the importance of focusing attention on the research problem rather than the method as well as the use of pluralistic approaches to derive knowledge about the problem.

This practice-oriented approach allows the research to consider “what” and “how” to research based on its intended consequences. Within this research, the **Preliminary Stage, Phase One: Investigating Knowledge Gaps – Firm Perspective** phase helped the research to determine what to investigate, by providing insights into the sources of consumer food safety knowledge gaps during food incidents and by re-directing the researcher from the firm perspective towards focusing on the consumer perspective. It also helped the researcher to determine how to conduct the investigation, by directing the researcher towards the use of a quantitative approach in **Advanced Stage, Phase One: Investigating Knowledge Gaps – Consumer Perspective** which led to the subsequent phases of the research.

3.2.3 Mixed Method Research Methodology

Mixed methods research approach involves utilising multiple methods within a research investigation (Tashakkori and Teddlie, 2003a, Teddlie and Tashakkori, 2003b, Venkatesh et al., 2013). More specifically, Venkatesh et al. (2013), defined mixed methods as follows;

“Mixed methods research uses quantitative and qualitative research methods, either concurrently (i.e., independent of each other) or sequentially (e.g., findings from one approach inform the other), to understand a phenomenon of interest”.

Based on the consumer-focused nature of this research, which considers Australian consumers’ safe food management practices, it becomes questionable if a high regard is

not placed on the reality of, and the influence of, the inner world of human experience in action (Johnson and Onwuegbuzie, 2004). On the other hand, identifying consumers' food safety knowledge gap areas require a practical empiricism. Therefore, it can be argued that this complicated phenomenon should be investigated in a way that recognises "the existence and importance of the natural or physical world as well as the emergent social and psychological world that includes language, culture, human institutions, and subjective thoughts" (Johnson and Onwuegbuzie, 2004), which is a classic characteristic of mixed methods research approach.

Furthermore, as it is imperative to explicate the purpose for selecting a mixed method approach, the researcher particularly draws on Creswell et al. (2003), Greene et al. (1989), Tashakkori and Creswell (2008). According to their works, the purposes for using mixed method approach in a research inquiry include: complementarity, completeness, developmental, expansion, corroboration/confirmation, compensation, and diversity.

In this study, the incorporation of mixed methods within the first phase of the research (Investigating Knowledge Gaps) is for **exploratory or developmental** purposes. According to Venkatesh et al. (2013), developmental or exploratory here means that "mixed methods are used in order to determine the questions for the next strand of the study based on the inferences obtained in a previous strand of a study". This is relevant to this investigation, as findings from the qualitative **Preliminary Stage, Phase One: Investigating Knowledge Gaps – Firm Perspective**, which concerns the role played by a firm in updating consumers' food safety knowledge during a food recall incident, was expanded upon by examining findings from a quantitative study concerning Australian consumers food safety knowledge gaps during normal day to day activities in **Advanced Stage, Phase One: Investigating Knowledge Gaps – Consumer Perspective**. Other information systems research that have utilised the mixed method approach for this purpose are Koh et al. (2004) and Keil et al. (2007).

Whilst there are different typologies for mixed methods research (Morse, 2003), Creswell and Clark (2007) have argued for four major types of mixed methods designs:

1. Triangulation: This is a one-phase approach which involves merging complementary qualitative and quantitative data, with equal weight, to understand a research problem.
2. Embedded: This involves using either qualitative or quantitative data to answer a research question within a largely quantitative or qualitative study.
3. Explanatory: This involves a two-phase approach which starts with the collection of quantitative data followed by subsequent collection of qualitative data.
4. Exploratory: This involves a two-phase approach which starts with collecting qualitative data to explore a phenomenon and then build on the results by collecting quantitative data.

Drawing on Teddlie and Tashakkori (2006), the researcher concurs it is beneficial to identify a mixed method research typology for a research investigation as it provides the ideal approach which will be selected in order to complete the study. The **sequential exploratory mixed methods research typology** is deemed suitable for the Phase one of this investigation for two reasons. First, this study requires some qualitative data in order to determine the landscape within the Australian food industry in relation to food safety processes so as to identify sources of consumer food safety knowledge gaps. Second, having identified sources of consumer food safety knowledge gaps between the industry and food consumers, then the study requires some quantitative data in order to identify Australian consumers' safe food handling practices while identifying the knowledge gap areas of the consumers in Phase one of the study. This design is particularly useful and relevant to this Phase of the study for the following reasons (Creswell et al., 2003);

- At the inception of this research, there was no guiding principle or framework. Therefore, it was important to begin the study qualitatively in order to explore the phenomenon being investigated.
- It was important to identify the important variables to investigate quantitatively amongst Australian consumers.

Furthermore, **Phase Two: Design and Development of the Safe Food Management App** utilises a purely qualitative approach in order to provide insights into the design of the smartphone which will be implemented and evaluated. However, **Phase Three: Implementing and Evaluating the Safe Food Management App** utilises a purely quantitative approach in order to implement and evaluate the effectiveness of the safe

food management app that has been developed. Therefore, based on Phase one, Phase two and Phase three of the study, a **mixed method research approach** is adopted, as shown in Figure 3-1.

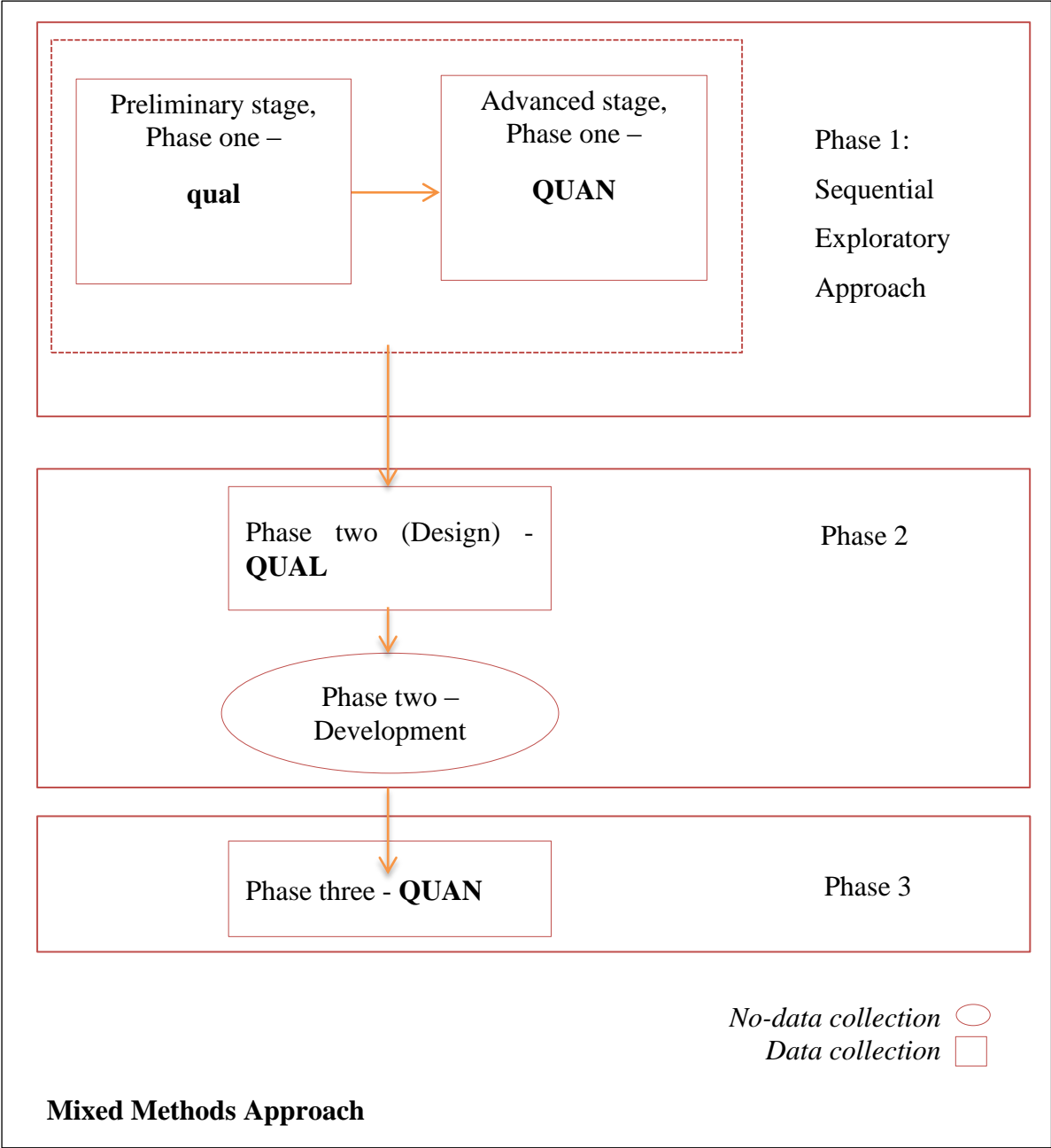


Figure 3-1: Mixed Methods Research Approach

3.3 Research Strategy

This section discusses the research strategies employed in order to conduct this investigation. The process of data collection incorporates a single case study (**Preliminary Stage, Phase One: Investigating Knowledge Gaps – Firm Perspective**), a survey (**Advanced Stage, Phase One: Investigating Knowledge Gaps – Consumer Perspective**), a usability study (**Phase Two: Design and Development of the Safe Food Management App**) and a field experiment (**Phase Three: Implementing and Evaluating the Safe Food Management App**). These were embedded in a three-phase data collection strategy as follows: **Phase one** - Preliminary Stage and Advanced Stage; **Phase two** – Design and Development of the Safe Food Management App and **Phase three** – Implementing and Evaluating the Safe Food Management App. The research methods and strategies adopted by this research are influenced by the philosophical assumptions underpinning this research which has been discussed earlier (see sections 3.1 and 3.2).

3.3.1 The Case Study Strategy

The first research strategy adopted in this study is the Case Strategy. The case is defined by Miles and Huberman (1994) as “a phenomenon of some sort occurring in a bounded context”. Hence, the case is a researcher’s unit of analysis (Miles and Huberman, 1994) which is tailored towards responding to “how” and “why” questions about a particular phenomenon (Leonard-Barton, 1990). As defined by Yin (1989), a case is an empirical enquiry that “investigates a contemporary phenomenon within its real-life context and addresses a situation in which the boundaries between the phenomenon and context are not clearly evident”. A key attribute of the case research strategy is that multiple types of data are usually collected (Patton, 1990).

In information systems research, the application of a case study research strategy is considered acceptable (Lee, 1989) where research and theory has been formulated at an early stage with little theoretical base (Galliers and Land, 1987, Galliers, 1992). More specifically, Benbasat et al. (1987) and Myers (1997) have argued that the case study research is most appropriate for the development, implementation and use of information systems. Though the case study research has been used in a quantitative manner (Yin, 1989), there has been an extensive increase in the qualitative use of case research due its ability to explore the “how” and “why” questions (Walsham, 1995).

According to Urquhart (1999), the case study strategy has the ability to bring four dimensions to research. It has the ability to produce rich insights from data, draw certain implications; develop concepts from data and to provide a foundation to generate theory. This research adopts the case study strategy in order to generate insights into the role played by a food firm in updating consumers' food safety knowledge during a food recall incident. Also, this strategy has been adopted in Phase one in order to determine the communication flows and/or gaps between the firm and its consumers when food safety has been compromised; thus leading to the identification of the sources of consumer food safety knowledge gaps. This is an exploratory single case.

3.3.2 The Usability Study Strategy

This research adopts the usability study strategy leveraging on the advantages of this approach, as highlighted in section 2.2.3, in order to determine whether and how safe food management app designs differ from generic app design principles by evaluating how consumers respond to existing food safety apps which are based on diverse information designs (text-based apps, audio-visual apps and integrated apps). This aims to identify considerations that should be made when designing and developing the safe food management app to specifically address consumers' safe food management knowledge gaps during normal day to day food handling activities. But more specifically, it provides the participants with the ability to compare different app designs which is in consonance with another advantage of the usability strategy.

To achieve this, first, the researcher selected three apps (text-based app, audio-visual app and integrated app) based on the criteria in section 3.3.2.2, and conducted heuristic evaluation based on Monkman and Kushniruk (2013) framework in order to identify problems with existing apps on safe meat cooking, from an expert's perspective. Safe meat cooking was selected due to the outcome of Phase one of the study. The framework was selected due to its relevance for the context defined in this study. It is based on the following usability factors; screen, content, display, navigation and interactivity. The heuristics were developed (through the modification of design guidelines) for evaluating health app usability, as earlier discussed. Based on the frequency, impact and persistence of usability problems, a three-level severity scale was utilised with numbers 1, 2 and 3 representing mild, moderate and severe respectively.

Second, the researcher used a scenario based focus group session as well as the card sorting technique to conduct the consumer based evaluation of the three existing apps. Following this, the researcher combined the outcome of the heuristic evaluation of all three apps with the outcome of the consumer evaluation.

3.3.2.1 Initial Participant Recruitment

Participants were initially recruited via poster invitations between August and October 2015 at supermarkets and butcher stores in Tasmania. To ensure a broad spread of participants, poster invitations were also presented to students who were not studying Information Technology. Participants met the study inclusion criteria if they cook red meat; if they have a smartphone (specifically an android 4.0.3 or an iPhone 4 and later versions) and if they are Australian adults (18 years and above). Participants were excluded if they did not have a smartphone that conformed to the requirements and if they were not living in Australia in order not to bias the data as the study is focused on the Australian context only.

3.3.2.2 Existing App Selection

As previously stated, this research involves the selection of three existing apps (text-based app, graphics/picture-based app and integrated app) that most clearly addresses the safe food handling practice being targeted, in this case – safe meat cooking. An app is defined as “text based” if it mainly communicates with its users based on textual information modality. An app is defined as “text and picture based” if it mainly communicates with its users based on textual and visual information modalities. An app is defined as “integrated” if it mainly communicates with its users based on textual, visual, and sound/audio information modalities.

Existing applications were selected to facilitate:

- Easy and low cost investigation of three different information modalities which will support users (non-technical; food consumers) to become rapidly familiar with these modalities thereby enabling them to contribute to subsequent preferences for design by having provided them with some concrete examples to work from in the first instance (Houde and Hill, 1997).

- A more effective collection of true human performance data as there is evidence to suggest that a high-fidelity prototype/fully functional prototype provides a more valid evaluation than a paper or low fidelity prototype (Lim et al., 2006).
- There is also a precedent for this type of approach in developing mobile solutions using existing applications (Fleury et al., 2010).

The three apps were selected based on the following criteria: it must be focused on end-consumers not professional food handlers; it must contain the appropriate meat cooking temperature and cooking time; it must be given a minimum of 4 out of 5 star rating. These are the apps' summary ratings which are informed by individual user ratings (Apple, 2018). Due to ethical restrictions, only the pseudo-names can be specified. Therefore, the text based app is herein referred to as TbA; the picture and text based app is herein referred to as PTA while the integrated app is herein referred to as InA.

3.3.3 Field Experiment

According to List and Metcalfe (2014), conducting field experiments in the Social Sciences involves “the application of experimental methods in the real world (field), that is, with actual participants rather than in the laboratory with student subjects”. Indeed, there are contentions about the efficacy of the use of field experiments when compared to laboratory experiments in terms of the generalisability of results and the level of control each approach offers the researcher (Al-Ubaydli and List, 2015). However, it has been argued that field experiments provide greater generalisability (Levitt and List, 2007) and laboratory experiments do not necessarily provide greater control (Al-Ubaydli and List, 2015). Al-Ubaydli and List (2015) have argued that laboratory experiments may provide “greater control over the physical environment and the nature of permissible interactions”, but they also have the potential “to offer researchers less control over the nature of the participants”. Therefore, the notion that laboratory experiments are better than field experiments is not necessarily appropriate due to the preceding arguments and the different context in which diverse research is conducted. Thus, due to the nature of this research, in terms of its focus on food consumers, a field experiment is more appropriate. However, whilst this research has drawn upon the definition of field experiment provided by List and Metcalfe (2014), it is important to highlight here that the focus was on ‘actual participants’ rather than ‘real world’.

Therefore, *field experiment in this research refers to the application of experimental methods with consumers.*

3.3.3.1 Randomised Field Experiments

There are two main types of field experiments: randomised field experiment and non-randomised field experiment. Randomised field experiments “allows researchers to scientifically measure the impact of an intervention on a particular outcome of interest through random assignment of study subjects” (ISPS, 2012). On the other hand, non-randomised field experiments are “quantitative studies estimating the effectiveness of an intervention (harm or benefit) that does not use randomization to allocate study subjects to comparison groups” (Reeves et al., 2008). It has however been argued that randomised field experiments are the ‘gold standard’ as they yield the most accurate analysis of the effect of an intervention (ISPS, 2012) and that they are better than their non-randomised counterparts for the following reasons;

- Unlike randomised field experiments, non-randomised studies are more likely to have potentially greater biases in terms of selection bias and reporting bias (Reeves et al., 2008).
- Unlike randomised field experiments, non-randomised studies have the potential to provide seriously misleading results due to similar key prognostic factors in both experimental and control groups (Deeks et al., 2003).

Based on the aforementioned reasons, Deeks et al. (2003) have argued that non-randomised studies should only be conducted when randomised counterparts are not feasible or when they are unethical. Therefore, due to the enormous benefits of randomised field studies, this research incorporates the randomised field experimental approach to implement and evaluate the safe food management app.

In this study, there was an experimental group and a control group. The experimental group is the group that received the intervention being studied (the safe food management app) while the control group is the group that did not receive the intervention, instead they used a paper-based tool. Whilst it was intended to utilise and compare the initial focus group participants that participated in evaluating the three existing apps with the newly recruited participants, it was impossible to do so. This is

due to the lack of availability of the focus group participants as it was difficult for most of them to commit to a 4-week experiment.

3.3.3.2 Final Participant Recruitment

Due to the challenges experienced in the initial participant recruitment (in Phase 2 – see section 3.3.2.1) which fetched a limited number of participants, the researcher decided to utilise a different method for the final recruitment (in Phase 3). Therefore, participants were recruited via electronic poster invitations between January 2016 and February 2016 on five electronic advertisement channels focused on Hobart, Tasmania. The electronic advertisement channels utilised for the purpose of this study are as follows; GumTree Australia website, Facebook page created for the research, Google adwords, Locanto free classified Hobart advert website and Global free classified Hobart advert website.

First, the advertisement placed on the GumTree Australia website contained the details of the poster shown in Appendix B. Care was taken to ensure that participants that could bias the data were not targeted based on the classification of the advert. For example; a page focused on job-seekers would bias the research data. Therefore, to avoid such types of bias, the research placed the advert within the group related to ‘community’ as it was the only classification that was most related to the public health issue (food safety) being investigated in this research. This was a paid advertisement. The same procedure and care was taken for the advert placed on Locanto free classified Hobart advert website and Global free classified Hobart advert website. The only difference is that they were free adverts.

In addition, as shown in Appendix B, the advertisement was placed in a Google doc page to ensure that potential participants have access to the information on the page. This page was then linked to the Google AdWords as well as the Facebook page. The advert placed on the Google AdWords and the Facebook page were also paid. Once participants got access to any of the five advert channels, they were prompted to complete a survey through a Survey Monkey link so that the researcher can determine if the participants qualify for the research.

Participants met the study inclusion criteria if they purchase and cook red meat; if they have a smartphone (specifically an android phone 4.0.3 or an iPhone 4 and newer versions) and if they are Australian adults (18 years and above). Participants were

excluded if they did not have a smartphone that conformed to the requirements and if they were not living in Australia in order not to bias the data as the study is focused on the Australian context only. The recruitment efforts, which spanned across three months, could only recruit 12 participants out of which 4 dropped out due to family emergencies. As this is an interpretive study, the remaining eight participants were deemed sufficient.

3.3.3.3 Stratified Randomization

In order to eliminate selection bias; to balance arms based on the prognostic variable; and to ensure an assumption free statistical test of the equality of treatments, it was imperative to incorporate the appropriate randomization procedure (Shen and Lu, 2006). In order to achieve this, three important criteria for randomization were followed; unpredictability, balance and simplicity. Thus, Shen and Lu (2006) have argued that each participant should have the same chance of receiving any of the interventions; the groups should be alike in all important aspects; and it should be easy for the researcher to implement. Therefore, to achieve randomization, there are four techniques; simple randomization, block randomization, stratified randomization, and covariate adaptive randomization.

Of these techniques, stratified randomization was deemed most appropriate for this research because it addresses the need to balance and control the influence of co-variables in order to avoid any risk to the conclusions of the study (Suresh, 2011). Whilst this method is difficult to implement for larger studies, it is deemed more appropriate and simple for smaller studies with limited sample size (Shen and Lu, 2006). Moreover, it is also appropriate for this study because all the participants have been identified through the recruitment process before group assignment (Suresh, 2011). Therefore, like Skarphedinsson et al. (2015), the researcher chose to incorporate stratified randomization.

As earlier discussed, the influence of co-variables is one of the major reasons why stratified randomization was selected. Hence, it is imperative to discuss the two co-variables that could influence this research; gender and age group. First, one important criterion for each potential participant to fulfil is the ability to purchase and cook meat which is generally about food preparation in the home. There is evidence to support the argument that food preparation is a strongly gendered household task (Blake et al., 2009, Hartmann et al., 2013). In agreement, Worsley et al. (2014) have argued that cooking

remains a female responsibility in Australia, thus portraying the importance of gender as a co-variate in this study. Second, the other criterion that must be fulfilled by each potential participant is the ownership and use of smartphones. There is also evidence to support the argument that electronic channel preferences through the use of smartphones is more preferred by a younger class of Australians (Worsley et al., 2014), thus portraying the importance of age group as a co-variate in this study.

Therefore, to randomize participants, a stratified randomization procedure was applied. Gender and age group were used as stratification variables, to provide a total number of strata of six as much as it was possible based on the available participants, as previous evidence suggests that they have the potential to moderate intervention outcomes. Following this, each participant was selected through simple randomization. To ensure that randomization could not be predicted in advance, the randomization procedure utilised tags only as shown in Table 3-1.

Table 3-1: An Example of Stratified Randomization Outcome

Age	Gender	Selected code through simple randomization
18 - 29	Male	Candidate 6
30 - 49	Male	Candidate 5
50+	Male	Candidate 1
18 - 29	Female	Not available
30 - 49	Female	Candidate 3
50+	Female	Candidate 7

3.3.3.4 Procedure

As earlier discussed, knowledge optimisation involves ensuring that knowledge acquisition occurs, the knowledge has been retained and the knowledge can be applied (see section 2.1.2). Drawing upon the revised version of Bloom's Taxonomy of meaningful learning (Mayer, 2002), achieving knowledge optimisation requires three of the six cognitive processes; remember, understand and apply. The other three are

analyse, evaluate and create. In this study, ‘remembrance’ demonstrated the level of knowledge acquired, ‘understanding’ demonstrated the level of knowledge retained and ‘application’ demonstrated the level of knowledge applied. These were assessed using multiple choice questions for knowledge acquisition, problem based learning approach using scenario-based questions for the knowledge retention and knowledge application processes as earlier discussed in sections 2.1.2.1, 2.1.2.2 and 2.1.2.3.

As the aim of this research was to investigate how consumers knowledge acquisition (see section 2.1.2.1), knowledge retention and perceived behavioural change is influenced by an information design on safe food management, it was deemed sufficient to investigate only the first three cognitive processes. Whilst the ability to demonstrate that consumers can remember, understand and apply the acquired knowledge portrays that the knowledge of the consumers has been optimised, it also confirms that those consumers have indeed retained the knowledge.

Following on from similar studies (Zydney and Warner, 2016), ‘remembering’ has been evaluated after the use of a mobile app for knowledge acquisition (Ahmed and Parsons, 2013, Pi-Hsia et al., 2012). In a study by Ahmed and Parsons (2013), their method involved quantitative assessment through a post-test that was delayed for two-months after the instructional period. They also used questionnaires for the pre and post-tests.

Furthermore, ‘understanding’ has been evaluated after the use of a mobile app for knowledge acquisition in many studies (Chiang et al., 2014, Chu et al., 2010, Dekhane and Tsoi, 2012). What these studies have in common is their use of pre- and post-test format and multiple choice or short answer questions to assess conceptual understanding (Zydney and Warner, 2016). Their questions are typically derived from a curriculum, a standardized test, or created by experienced teachers or researchers.

In addition, ‘applying’, which is also known as ‘knowledge application’ has been evaluated after the use of a mobile app for knowledge acquisition (Hwang et al., 2012). In a study by, Hwang et al. (2012) their method also involved the use of questionnaires for pre and post-tests. It is however worthy to note here that the aforementioned studies on ‘remembering’, ‘understanding’ and ‘applying’ have been conducted based on pedagogical frameworks, as none of those studies have been conducted based on adult

learning frameworks situated within the safe food management space focused on consumers (see section 2.4.3.1 for further discussion).

Therefore, as these studies have made use of questionnaires and short answer questions in some cases for the pre- and post-tests, the researcher has also drawn upon this methodological approach. In this study, there is a pre-test, an intervention and three post-tests. The pre-test (baseline) questionnaire is based on Gong et al. (2016), Hassan and Dimassi (2014), Lazou et al. (2012), Byrd-Bredbenner et al. (2007) (*see Appendix C*). The first level of the post-test question is the same as the pre-test question but the only difference is that the questions and answer options are re-ordered. The second and third levels of the post-test questions are strongly aligned to the pre-test questions (*See Appendix D for level 2 post-test questions and Appendix E for level 3 post-test questions*).

The decision to space the post-intervention days is based on an argument, relying on empirical evidence, that learning opportunities dispersed over time produce greater recall than learning opportunities which are massed (Delaney et al., 2010, Clark, 2014, Cepeda et al., 2009, Kerfoot et al., 2007, Hillary et al., 2003). Whilst it is widely accepted that spacing learning opportunities enhances retention, Karpicke and Bauernschmidt (2011) have argued that there is no evidence suggesting that a certain relative spacing schedule (expanding, equal or contracting) is more superior than the other. Therefore, the researcher has decided to space the learning sessions with weekly intervals based on the availability of the participants and convenience. The decision to include the brainstorming session for both the intervention and control groups is based on existing arguments in the literature that more learning occurs when the process of learning includes active learning strategies such as discussions or brainstorming session (Grunert O'Brien et al., 2008, Yacobucci, 2012). The decision to allow the participants to take the study material (app or document) home for further study at their own pace is based on evidence from decades of research that have revealed no reliable contributions of the amount of study time and test performance (Tock, 2013) for non-experts in a subject matter. Therefore, as the number of study hours does not necessarily correspond to the level of knowledge increase, the author decided to allow the participants to take the learning materials home for follow-up study at their own pace.

Following this, the participants' perceived behavioural change was assessed six weeks after the experiment for each individual. Biran et al. (2014) detected behavioural change on handwashing after six weeks; thus suggesting that six weeks is an adequate timeframe within this research context especially in cases where the research is time-constrained. This provided a clear picture of the impact of the 4-week experiment for each participant. Table 3-2 provides the detail of how the experiment was conducted.

Table 3-2: Details of Field Experiment Procedure

S/N	Context	Timeline	No Intervention Group	Intervention Group	
1	Participants: <ul style="list-style-type: none">Age groupGender	-	<ul style="list-style-type: none">4 participants	<ul style="list-style-type: none">4 participants	
Day 1 - Intro		15 minutes	Briefing, Information Sheet and Consent Form		Day 1: 2 hours
2	Pre-Intervention	Day 1 (30 minutes)	<ul style="list-style-type: none">Baseline QuestionnaireClosed ended questions	<ul style="list-style-type: none">Baseline QuestionnaireClosed ended questions	
3	Intervention: Actual Information Acquisition	Day 1 (1 hour)	<ul style="list-style-type: none">Read: Use a document to answer the baseline questionnaire (copy 2) – 30 minutesHear and Speak: Have a brainstorming session on the facts in the document – 30 minutesClosed ended questions	<ul style="list-style-type: none">Read: Download the app and use it to answer the baseline questionnaire (copy 2) – 30 minutesHear and Speak: Have a brainstorming session on the facts in the document – 30 minutesClosed ended questions	
Day 1 - Ends		15 minutes	De-briefing		
Day 8 - Intro					8: Day
		5 minutes	Briefing		

4	Post-Intervention 1: Demonstrate Information and/or Knowledge Acquisition through Remembering	Day 8 (20 minutes)	<ul style="list-style-type: none">No documentSame baseline questionnaire but with re-ordered questions and answer options20 minutes	<ul style="list-style-type: none">No app usageSame baseline questionnaire but with re-ordered questions and answer options20 minutes	
Day 8 - Ends		5 minutes	De-briefing		
Day 16 - Intro		5 minutes	Briefing		Day 16: 40 minutes
5	Post Intervention 2: Demonstrate Knowledge Retention through Understanding	Day 16 (30 minutes)	<ul style="list-style-type: none">No documentScenario based questions related to the facts in the questionnaireOpen-ended / Short answer questions30 minutes	<ul style="list-style-type: none">No app usageScenario based questions related to the facts in the questionnaireOpen-ended / Short answer questions30 minutes	
Day 16 - Ends		5 minutes	De-briefing		
					Day 24: 45 minutes
Day 24 - Intro		10 minutes	Briefing		
6	Post-Intervention 3: Demonstrate Knowledge Application	Day 24 (30 minutes)	<ul style="list-style-type: none">No documentReal Life scenario in a kitchen environmentOpen-ended / Short answer questions30 minutes	<ul style="list-style-type: none">No app usageReal Life scenario in a kitchen environmentOpen-ended / Short answer questions30 minutes	
Day 24 - Ends		5 minutes	De-briefing		

Day 70 – Post-Experiment Assessment after 6 weeks	15 minutes	<ul style="list-style-type: none"> • Phone conversation • Closed-ended questionnaire from baseline questionnaire • Open-ended questionnaire • 15 minutes 	Day 70: 15 minutes
----------------------------------------------------------	------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------

3.3.4 Three Phase Data Collection

This section presents the three phase strategy which envelopes the case study, the usability strategies and the field experiment that were declared in sections 3.3.1, 3.3.2 and 3.3.3 above. The first data collection phase occurred between July 2014 and July 2015. The second data collection phase occurred between August 2015 and December 2015. The third data collection phase occurred between February 2016 and June 2016.

The first phase of data collection focused on identifying knowledge gaps in domestic safe food management. This phase consists of the **Preliminary Stage, Phase One: Investigating Knowledge Gaps – Firm Perspective** and the **Advanced Stage, Phase One: Investigating Knowledge Gaps – Consumer Perspective**. The preliminary stage – firm perspective stage involved the single case study of the food firm that experienced a food recall incident with a view on exploring the landscape in order to generate insights into the role played by a food firm in updating consumers’ food safety knowledge during a food recall incident. Also, this helped to determine the communication flows and/or gaps between the firm and its consumers when food safety has been compromised; thus leading to the identification of the sources of consumer food safety knowledge gaps. The outcome of this stage answered the first objective for the first research question (RQ1 O1) and led to a focus on consumers rather than firms. Following this stage, the advanced stage – consumer perspective involved the survey of Australian consumers with a view on expanding on the insights from the preliminary stage – firm perspective. At the end of this phase, the researcher was able to identify the knowledge gaps in consumers’ safe food handling practices but more specifically, safe meat preparation/cooking. The outcome of this stage answered the second objective for the first research question (RQ1 O2). The findings from the first phase – identifying knowledge gaps - (both stages 1 and 2) answered the first research question and led to the second phase.

The second phase of data collection (**Phase Two: Design and Development of the Safe Food Management App**) focused on the considerations necessary for the design and development of a smartphone app to target the knowledge gaps that have been identified in the preceding phase. Utilised as a baseline, a paper-based tool was developed by the researcher based on one information modality – text, and the textual information was retrieved from the websites of the relevant government agencies. The smartphone app was developed based on three information modalities – text, pictures and videos (see section 2.3). While the textual information was the same as that of the paper-based tool, the design and development of the app was based on lessons learnt from existing food safety apps. This led to the adoption of the health literacy online heuristics framework while combining it with a consumer-based evaluation to holistically assess the usability of these applications, their contexts of use and attributes of the end-users. The outcome of this provided insights into the design principles that should be considered when designing a food safety app due to the uniqueness of the context of this study (see section 5.3.4, Table 5-9 for these insights). This answered the first objective of the second research question (RQ2 O1). The insights provided from this phase led to the design and development of the safe food management app. More specifically, the outcome of this phase led to the concept design of the smartphone app which was designed by the researcher. Following this, the researcher worked closely with two mobile application developers, for iOS and Android platforms, to ensure the development of the smartphone app. This answered the second objective of the second research question (RQ2 O2). The findings from the second phase – design and development of the safe food management app - answered the second research question and led to the third phase.

The third phase of data collection (**Phase Three: Implementing and Evaluating the Safe Food Management App**) focused on the implementation and evaluation of the developed smartphone app using the field experiment described in section 3.3.3. The safe food management app was implemented as an intervention in a field experiment. The impact of the app is evaluated through the post intervention activities as highlighted in section 3.3.3 to determine the impact of the smartphone app, on knowledge acquisition, knowledge retention and perceived behavioural changes. To achieve this, the evaluation helped to determine whether individual attributes and skills influence the use, utility and the user's perceived behaviour resulting from the use of the safe food

management app; and to identify whether and how the principle of modality effect influences knowledge retention when optimising the safe food management knowledge of consumers. The findings from the third phase – implementing and evaluating the safe food management app - answered the third research question and the associated objectives.

Section 3.3 has presented the research strategy utilised to ensure that the research objectives are fulfilled and that rich insights were obtained in regards to the research questions. This section has illustrated how the case study, usability strategy, field experiment and the three phase data collection strategies were appropriate for the philosophical stand point of this research and the phenomena under investigation. It is however important to note that survey is not discussed in this sub-section in order to avoid duplication as it is discussed as one of the tools and techniques of data collection in section 3.5.6.

3.4 Research Design

This section presents the research design, employed in this study. This thesis investigates how the affordances of smartphone technology can be leveraged to enhance the provision of information and facilitate knowledge retention. Thus, this study aimed to provide insights into how best to share information to facilitate knowledge retention through the use of technology in an attempt to improve the food management behaviour of Australian consumers. This resulted in the following overarching research question: How can the affordances of smartphone technology be leveraged to enhance consumers' safe food management?

The research design enabled the researcher to be able to address the following research questions:

Research Question 1: To what extent do gaps exist in consumers' food safety knowledge?

Research Question 1 Objective 1: To determine the role played by a food firm in updating consumers' food safety knowledge during a recall incident.

Research Question 1 Objective 2: To identify safe food management knowledge gaps in consumers.

Research Question 2: How can technology support the delivery of food safety information to consumers in a manner that facilitates better understanding?

Research Question 2 Objective 1: To identify whether and how safe food management app designs differ from generic app design principles.

Research Question 2 Objective 2: To design and develop a safe food management smartphone app.

Research Question 3: How does the use of a safe food management app influence consumer knowledge acquisition, knowledge retention and perceived behavioural change?

Research Question 3 Objective 1: To determine the impact of the app on consumer knowledge acquisition and knowledge retention.

Research Question 3 Objective 2: To determine the impact of the app on perceived behavioural change.

The research design was guided by the research philosophy (see section 3.2) and the research strategy (see section 3.3).

The research design mirrored the three phase research strategy and was arranged into three research phases.

Phase one:

- **Preliminary Stage, Phase One: Investigating Knowledge Gaps – Firm Perspective**

- **Advanced Stage, Phase One: Investigating Knowledge Gaps – Consumer Perspective**

Phase two:

- **Design and Development of the Safe Food Management App.**

Phase three:

- **Evaluating and Implementing the Safe Food Management App.**

This design ensured a holistic viewpoint on the research questions presented in chapter 1, section 1.2. Each of the stages will now be discussed.

Phase one was in two stages; **Preliminary Stage, Phase One: Investigating Knowledge Gaps – Firm Perspective** and the **Advanced Stage, Phase One: Investigating Knowledge Gaps – Consumer Perspective**.

Phase one, preliminary stage: The **Investigating Knowledge Gaps – Firm Perspective** stage included the use of semi-structured interviews, document reviews and field notes to gather data from a food firm that recently experienced a food recall incident. The data was gathered in order to generate insight into the role played by the food firm in updating consumers' food safety knowledge during the food recall incident. This was done by understanding the food recall issues and its implications on the firm; understanding the information and knowledge processes and flows; generating insight into the communication flows and gaps the firm had with their end consumers; identifying the information that was provided to the consumers immediately the recall occurred and identifying the information that was provided to the consumers after the safety situation was rectified. Three interviews, which spanned a total of 6 hours, were undertaken in this research design stage with the firm owner, a technical staff and a sales representative. The data gathered in Preliminary Stage, Phase One - **Investigating Knowledge Gaps – Firm Perspective** informed the conceptualization of the Advanced Stage, Phase One - **Investigating Knowledge Gaps – Consumer Perspective**.

Phase one, advanced stage: The **Consumer Perspective** stage included the use of a survey instrument to expand on the findings generated concerning Australian consumers. But more specifically, to identify the food safety knowledge gaps of consumers. To

achieve this, the survey focused on identifying the information that influences Australian meat consumers' purchase decisions, *identifying Australian meat consumers' safe food handling practices and behaviours* and identifying Australian meat consumers' information design preferences. The focus was on raw meat due to its high risk of causing cross contamination compared to other food types. This is based on the argument that, apart from commercially prepared food, the consumer home has the highest percentage of food poisoning outbreaks in Australia (OzFoodNet, 2012) and raw meat was one of the major contributors to this as they sometimes contain harmful bacteria such as *Salmonella*, *Listeria*, *Campylobacter* and *E. coli* (NSWFA, 2015b). 217 Australian meat consumers were surveyed in this research design stage. The data gathered in Phase one, advanced stage: The **Consumer Perspective** stage identified the food safety knowledge gap area – safe meat preparation/cooking - requiring an intervention and provided insight into how to assist consumers in empowering themselves by leveraging the pervasiveness and personalised nature of smartphones which led to Phase two – **Design and Development of the safe food management app**.

Phase two – **Design and Development of the safe food management app** involved the design and development of a smartphone app in a way that targets the knowledge gaps that have been identified in the preceding phase. As a baseline, a paper-based tool was developed by the researcher based on one information modality – text, and the textual information was retrieved from relevant government agencies. The smartphone app was developed based on three information modalities – text, pictures and videos (see section 2.3). While the textual information was the same as that of the paper-based tool, the design and development of the app was based on lessons learnt from existing food safety apps. Thus, there was a need to three existing apps (text-based, picture-based and integrated) that addressed the knowledge gap area identified in phase one (safe meat preparation) based on a set of criteria (*see section 3.3.2.2*). Following this, the researcher adopted the health literacy online heuristics framework and combined it with a consumer-based evaluation to holistically assess the usability of these applications, their contexts of use and attributes of the end-users. To achieve this, first, the researcher conducted a heuristic evaluation of all three apps to identify problems based on Monkman and Kushniruk's approach (*see section 3.3.2*). Second, the researcher conducted a consumer based evaluation of all three apps through a scenario based focus group session with nine participants (*see section 3.3.2.1*). In this session, participants

were asked to fill a questionnaire on demography and the selection criteria to ensure they indeed qualified to participate. Next, they were asked to answer closed ended questions while using the apps. Next, they were asked to write the issues and the benefits of each app on blank cards through a collective process and the card sorting technique was applied. Following this, they were asked to answer open ended questions related to the apps without using the apps. The data gathered during this phase, by combining the heuristic and consumer evaluations, informed the design and development of the smartphone app. The researcher achieved this by developing the concept design and by working closely with 2 application developers, one for the iOS platform and the other for the Android platform between January 2016 and February 2016. Following the successful development and launch into the app store and google play, the app was ready as an intervention tool. This phase was informed by data from the Advanced stage, Phase one and, in itself, informed Phase three.

Phase three – **Implementing and Evaluating the safe food management app** involved the commencement of the field experiment which comprised of the pre-test, intervention, and three levels of post-test. The **pre-test** involved the use of a baseline questionnaire to determine the current food safety knowledge of the participants. The **intervention** involved an information acquisition session for all the participants that included reading, hearing and speaking. However, only the experimental group was able to use the app individually to answer the questions in another copy of the baseline questionnaire. The control group used the paper-based tool individually which contained all the textual information in the app to achieve the same task. Following this, each group converged to have a brainstorming session which facilitated the ‘hearing’ and the ‘speaking’ of the facts in the learning materials. After the intervention, all participants were allowed to take their learning materials (app or paper-based tool) home for follow-up study at their own pace. The **first level of the post-test** was aimed at demonstrating that the participants could remember what was learnt during the intervention through the use of the same baseline questionnaire which has its questions and answer options re-ordered. The **second level of the post-test** was aimed at demonstrating that the participants could understand what was learnt during the intervention through the use of a scenario based questionnaire which required short answers in the participant’s own words. The **third level of the post-test** was aimed at demonstrating that the participants could apply the knowledge acquired during the intervention through the use of open-

ended questions based on real occurrences in a kitchen environment. A total of 8 participants participated in the field experiment. Figure 3-2 illustrates the research design.

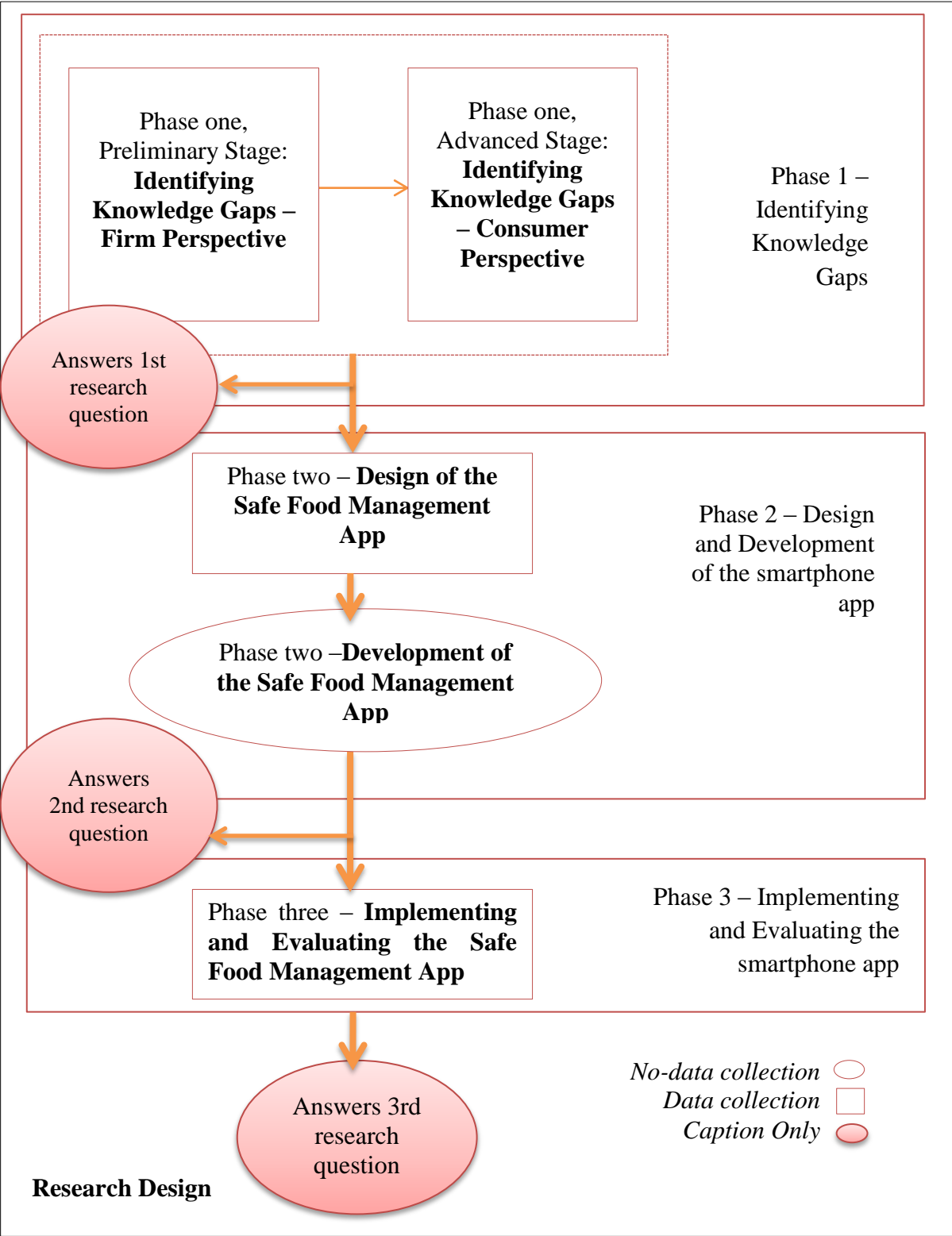


Figure 3-2: Research Design

Section 3.4 has presented the research design that supports the research strategy and the three phase data collection approach. The next section presents the tools and techniques that support the research strategy and research design.

3.5 Tools and Techniques

This section presents the tools and techniques that support the research strategy (see section 3.3) and carried out the research design (see section 3.4). The tools and techniques included semi-structured interviews, focus groups, document reviews, field notes, card sorting technique and survey/questionnaire. It is however worthy of note here that the term survey and questionnaire are used interchangeably in this study. These data collection techniques supported the aim of the research as presented in section 1.2. The research tools and research techniques are discussed in the following sub-sections and presented in Figure 3-3. It is however worthy of note here that, where multiple data collection tools were used, the primary mode of data collection is the first tool specified which was also italicized in Figure 3-3.

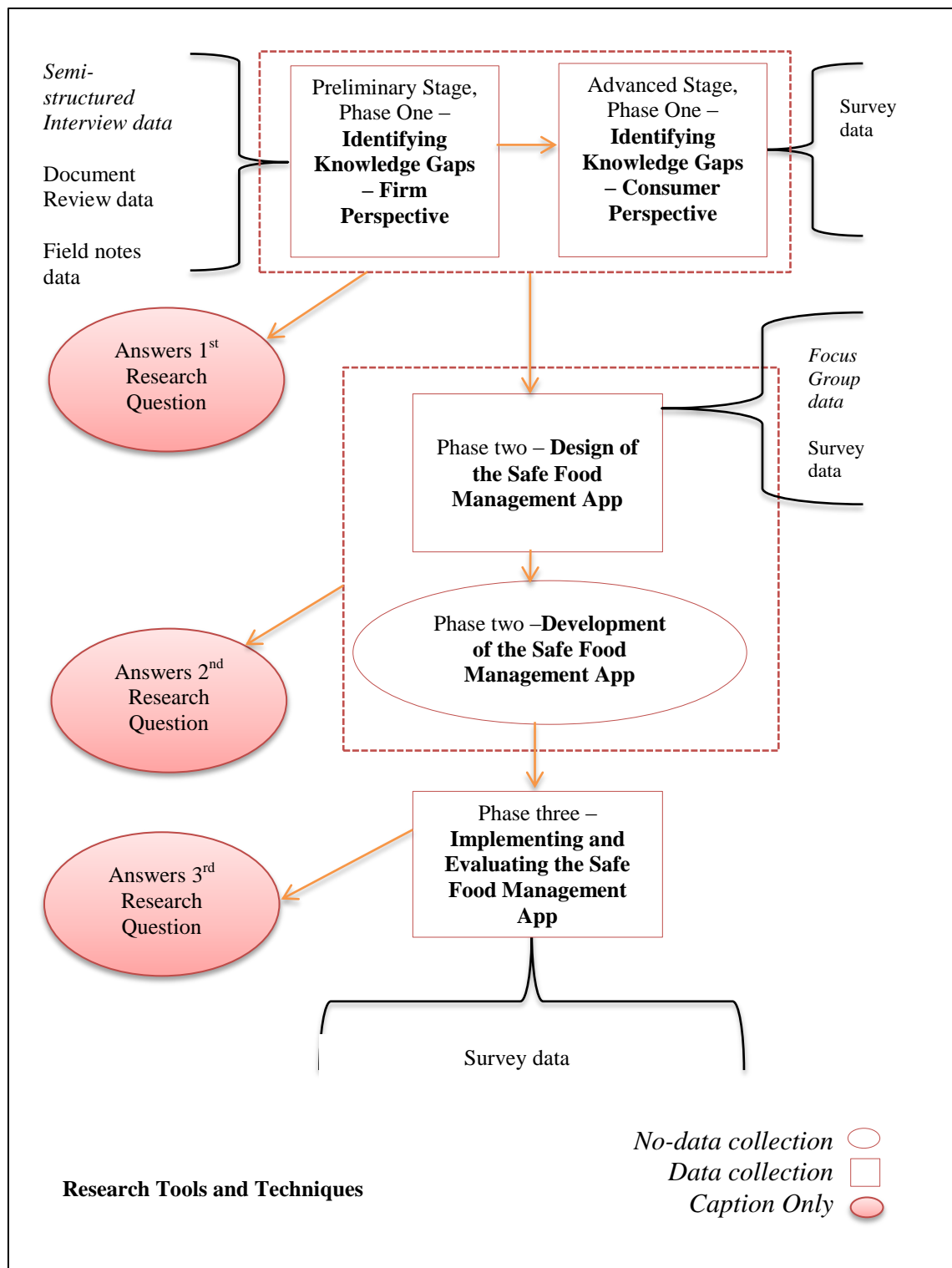


Figure 3-3: Research Tools and Techniques

3.5.1 Semi-Structured Interviews

In this study, the interviews conducted were semi-structured in design. Permission was requested and granted from all interviewees to be involved in the interview process. Each interview session was audio recorded with the consent of the research participants which was obtained in writing. The interviews ranged from 30 minutes to 5 hours in length. The researcher followed the question guide while using follow up questions where additional information was needed. A full list of the questions used in the participant interviews can be found in Appendix F.

At the conclusion of each interview, the researcher reviewed the audio file in order to reflect on the detailed answers received from the participants and on closed responses which facilitated further questions and probes. The reflection of the interview assisted the researcher to complete the field note (see section 3.5.4). Please see Appendix for details on the rationale for choosing semi-structured interviews.

3.5.2 Focus Groups

The focus group session was conducted to facilitate consumer based evaluation on the three apps through a scenario based session and the card sorting technique. This helped to identify considerations that should be made when designing and developing a safe food management app to specifically address consumers' safe food management knowledge gaps during normal day to day food handling activities. This was done by;

- Identifying problems and benefits of each existing app to generate lessons to be learnt when developing food safety applications.
- Identifying how each participant responded to use of each of the diverse information designs (textual, visual, verbal and integrated) from the existing apps.

Please see Appendix AD for more details on the rationale for choosing focus groups and its use in this study.

3.5.3 Document Review

Document reviews was employed as a secondary data collection method in this study as it helped to track the changes and developments that have occurred in the firm investigated in the Preliminary Stage, Phase One. This helped to provide supplementary data which was required as a case research is associated with data from multiple sources.

This also helped to corroborate evidence from multiple sources (Bowen, 2009). The research questions guided the focus of the documents which were reviewed by the researcher. During the visit to the firm (Preliminary stage, Phase One – Firm Perspective), the researcher was able to gather relevant documents, with permission from the owner of the firm. After the interviews, the researcher reviewed each of the documents which served as evidence corroborating the responses received during the interviews. Please see Appendix AD for details on the rationale for choosing to use document review in the qualitative aspect of this study.

3.5.4 Field Notes

According to Silverman (2010), field notes provide additional assistance and detail in the data analysis of the research investigation, thus allowing a recollection of reflections and assumptions made when interpreting the data. A reflective diary was kept for each interaction with the research participants. This data source was then used to supplement the interviews held with the participants.

This data source assisted the researcher to recapitulate the previous events through the inclusion of detailed observation of prior visual or verbal occurrences (Silverman, 2010). Emerson et al. (1995) argued that field notes are useful in identifying and following processes in witnessed events; understanding how participants describe certain events; conveying participants explanations for details about events thus eliciting their theories of the causes of such occurrences and identifying practical concerns and constraints influencing people's lives (Silverman, 2010).

In this study, the field note was completed either on-site or when the researcher returned to a conducive environment where the handwritten notes could be digitized. Appendix G has an example of a field note from an interview session conducted during a site visit to the food firm. Whilst capturing information such as data, place, time topic, participants and personal notes, the field note also allowed the researcher to capture personal reflections in a manner that allows a separate entry for the factual and reflective portions of the note (Berg and Lune, 2004). This approach helped the researcher in the interpretation of the data.

The field notes were used as a secondary data collection source to supplement the semi-structured interviews as the primary data source and were integrated into the process of analysis. This helped in providing depth in both the analysis and the interpretation of the interview data.

3.5.5 Card Sorting Technique

In this study, the card sorting technique was used to identify problems and benefits of each app. There were a total of 108 blank cards for all three apps, thus having a maximum of 36 cards for each app (2 cards for benefits and 2 cards for issues which led to 4 cards per app for each of the 9 participants). This is in consonance with Zimmerman and Akerelrea (2002) who has argued that the total number of cards should be about 100. These 3x8 inch cards were colour coded to ensure that a certain colour is assigned to each app (Zimmerman and Akerelrea, 2002). This helps to facilitate cross-comparison between the apps. To avoid confusing the participants due to the number of apps being considered, only two criteria were used to evaluate the apps during the card sorting session; *issues* with the app and *benefits* of the app. Therefore, for each app, two blank cards were presented to the respondents so that they could write two issues – one for each card. Following this, the cards were collected and grouped together by the participants together with the facilitator as recommended by Zimmerman and Akerelrea (2002) in order to establish group consensus. After this was completed, the same process was repeated for the benefits of the app.

Having used a small sample of participants (nine), statistical analysis is not appropriate as advised by Nurmuliani et al. (2004). Therefore, the card sorting data from this study has been analysed using thematic analysis, in order to assess the commonality between the participants categorization. Please see Appendix AD for details on the rationale for choosing to use the card sorting technique.

3.5.6 Survey or Questionnaire

Please see Appendix AD for more details on the rational and use of survey as a data collection tool in this study. This research has utilised the survey tool in three areas; Advanced Stage, Phase One; Phase Two; and Phase Three.

3.5.6.1 Sampling

The survey conducted in the second aspect of phase one was targeted at consumers within a consumer panel database who met the inclusion criteria. The consumer panel utilised is 'The Online Research Unit' which holds ISO 20252 'Market Research Standard' and ISO 26362 – 'Global Access Panels' accreditations and they are also endorsed by the Association of Market and Social Research Organisations (AMSRO) which demonstrates their level of adherence to privacy and ethical standards. This organisation was utilised because of a number of reasons such as; their invitation-only policy which increases representation and minimizes self-selection bias; and their primarily offline panel recruitment policy which avoids a sample bias of being over representative of urban areas, heavy online users and young consumers.

The survey was targeted at consumers within a consumer panel database who met the inclusion criteria. The sample was chosen to be representative of men and women aged between 18 and 65 years, according to their proportions in the states and territories of Australia. The Online Research Unit used a quota sample drawn from their online database membership that offers point rewards for survey participants. In total, 217 of 278 (78%) eligible consumers within the consumer panel cohort responded.

In order to ensure the right respondents indeed filled the survey, several measures were taken. First, the consumer panel utilised for the data collection ensured that participants are living in Australia and they are above 18 years of age. Second, the participants were quizzed about their dietary intake. This is to ensure that survey respondents are not vegans, vegetarians, or only white meat eaters, as the survey will not be related to them. Third, the participants were also asked about where they shop, as a screening question, in order to ensure that online grocery shoppers were excluded from the survey. The nature of the research context relates to how raw meat is usually handled from the point of purchase to the home. Online grocery shopping is outside of the scope for which the survey is intended.

3.5.6.2 Research Instrument

First, in the Advanced Stage, Phase One – Investigating Knowledge Gaps – Consumer Perspective, a survey was administered to Australian consumers in order to provide more insight into consumer food safety knowledge gap areas. More specifically, this was achieved by;

- Identifying the information that influences Australian meat consumers' purchase decisions.
- Identifying Australian meat consumers' safe food handling practices.
- Identifying Australian meat consumers' information and communication preferences.

The questions were designed by drawing on Table 3-3 which provides an overview of how each section was derived.

Table 3-3: Research Instrument Source

Survey Sections	Personal Comments	Constructs Measured	Sources of questions - References
Section A: Factors affecting consumer food safety behaviour	Mateus et al. (2014) argues that the factors are cultural, socio-economic, environmental and psychological (knowledge, attitudes, beliefs and values). These are addressed across the survey questions.	Food shopping habits, Attitudes toward eating meat, Price of meat products, Food safety, Sustainability and Welfare, Future consumption of meat, Lifestyle related questions	Smith and Riethmuller (1999), Williams et al. (2004), Grunert et al. (2014)
Section B: Existing and emerging consumer clusters (Information Dissemination)	Drawing on the determinants for information seeking proposed by Kuttschreuter (2006) and informed by the risk information	Consumers attitudes in relation to information (Information dependency, Interest in food information, motivation to find additional information, self-efficacy to find food information),	Kuttschreuter et al. (2014), Kuttschreuter (2006), Griffin et al. (1999)

Tool Clusters)	seeking model (RISP) (Griffin et al., 1999).	Perceived risks (consumer's general risk sensitivity, future facing risk perception)	
Section C: Consumers' information needs, perception and existing knowledge		General food safety knowledge; Existing food handling knowledge on Purchase, Transportation, Storage, Thawing practices, Cooking and re-heating left overs, kitchen hygiene practices	Williams et al. (2004), Gilbert et al. (2007)
Section D: Information dissemination in Australia		The appropriate information form, the appropriate information tone, the appropriate combination of information channels, the appropriate and trusted source of information	Kuttschreuter et al. (2014), Blanco et al. (2010), Lin et al. (2012), Ha and Lennon (2010), Jacob et al. (2010), De Jonge et al. (2007), Henderson et al. (2011)
Section E: Demography		Gender, Age group, Education, Marital Status, Living arrangements, Geographical Location, Household Income	Smith and Riethmuller (1999)

The survey sections in Table 3-3 above formed the basis of the questions styled in the maxdiff format (see Figure 3-4) and the other multiple choice questions. For the questions in the maxdiff format, each question typically contained a subset of 4 factors; the respondent would choose the most and least important factors within the subset. The question sets were balanced in factor frequency, positional frequency and orthogonality. This means that each factor appeared 4 times in total, and was paired with any other given factor once. This ensures that all factors have the chance to be compared against any other specific factor at least once within the same set. This arrangement was achieved by building a question matrix using the balanced incomplete block design technique which has been described elsewhere (Prescott and Mansson, 2004, Sawtooth, 2007). The full detail of the survey is shown in Appendix H.

Second, in Phase 2 – Design and Development of the Safe Food Management App, a questionnaire was administered to the participants before the focus group discussion as a secondary mode of data collection. This was needed to collect demographic data and to ensure that the participants were indeed qualified to participate. The full detail of the questionnaire is shown in Appendix I.

Third, in Phase 3 – Implementing and Evaluating the Safe Food Management App, an initial questionnaire was administered to the potential participants as part of the recruitment process (see section 3.3.3.2). This was needed to select the right participants and to collect their demographic data. The same questionnaire used in Phase 2 was used here as well (Appendix I). Within this task, there was a pre-test, an intervention and three post-tests. The pre-test (baseline) questionnaire is based on Gong et al. (2016), Hassan and Dimassi (2014), Lazou et al. (2012), Byrd-Bredbenner et al. (2007) (*see Appendix C*) which is a validated instrument that has been used multiple times in the literature. The first level of the post-test question is the same as the pre-test question but the only difference is that the questions and answer options are re-ordered. The second and third levels of the post-test questions are strongly aligned to the pre-test questions (*See Appendix D for level 2 post-test questions and Appendix E for level 3 post-test questions*).

While it has been specified that the term survey and questionnaire are used interchangeably in this study, one way to distinguish between how they have been used here is that the term survey was typically used in Advanced Stage, Phase One:

Investigating knowledge Gaps – Consumer Perspective while the term questionnaire was typically used in Phases Two and Three.

3.5.6.3 Reliability and Validity

Reliability refers to the consistency of a measure. A test is considered reliable if the researcher can get the same result repeatedly and an accurate representation of the total population. If the results of the study can be reproduced under a similar methodology and will not fail to perform within specified limits in a given time while working in a stated environment, the research instrument is considered to be reliable (Hernon and Schwartz, 2009, Sechrest, 1984, Carmines and Zeller, 1979).

Validity is the extent to which a test measures what it claims to measure. It is vital for a test to be valid in order for the results to be accurately applied and interpreted. Validity is not determined by a single statistic, but by a body of research that demonstrates the relationship between the test and the behavior it is intended to measure (Mendenhall et al., 1989, Hernon and Schwartz, 2009).

The face validity of the instrument was obtained by presenting the survey questions to the researcher's supervisors for initial vetting. After a few number of revisions, the survey questions were deemed valid. As Hyman et al. (2006) have stated that using pre-existing questions provide accurate measure as they are pre-tested before first usage, such that the degree of validity and the quality of the data are likely to be high. Hence, out of the various approaches to content validation discussed by Grover (1997) and Wynd et al. (2003), the content validity of the instrument in this study was addressed by using pre-existing questions and the literature from previous similar studies (see Table 3-3) which was modified to suit the current study.

Inspired by the pioneering study of the importance of pilot studies by van Teijlingen and Hundley (2001), the product of the modified questionnaire had to undergo a pilot study between February and May 2015. This was required to test the adequacy of the research instrument. The outcome of the pilot study, led to the final refinement of the questionnaire. In this study, the reliability and validity was obtained through the use of a pilot study. The pilot study helped to validate the questions asked in the research instrument. This was done by administering the initial set of questions to a few respondents.

3.5.6.4 Survey Administration

The online survey was administered through the services of Survey Gizmo (Boulder, CO, USA). Informed consent was obtained electronically. The link to the survey was provided to the consumer panel (The Online Research Unit) (see section 3.5.6.1). The consumer panel was then tasked with finding qualified research participants based on the selection criteria earlier provided (section 3.5.6.1).

3.5.7 Ethics

Ethics approval was received from the Human Research Ethics Committee (Tasmania) Network under reference number H0014010 (Appendix S) for the Preliminary Stage, Phase One of the study – Investigating Knowledge Gaps – Firm Perspective. At the end of this phase, another ethical approval was received from the same committee under reference number H0014658 (Appendix T) for the Advanced Stage, Phase One of the study– Investigating Knowledge Gaps – Consumer Perspective. On completion of Phase One, a third ethical approval was received from the same committee under reference number H0014965 (Appendix U) for Phases Two and Three of the study. The researcher was listed as the student investigator for the project.

This section of the chapter has presented the research tools and research techniques used in data collection which supported the research strategy (see section 3.3) and informed the research design (see section 3.4). Semi structured interviews were used to fulfil the research strategy requirements for the Preliminary Stage, Phase One of the study. Document reviews helped the researcher to uncover meaning, develop understanding, and discover insights relevant to the research problem. The use of field notes allowed the researcher to capture information made in the observations by the researcher. Survey helped to fulfil the research strategy requirements for the Advanced Stage, Phase One of the study. Focus groups and questionnaires assisted the researcher in fulfilling the research strategy requirements in Phase two of the study. The use of pre- and post-test questionnaires in the field experiment helped the researcher evaluate the safe food management app in Phase three of the study, thus answering the third research question.

The next section presents the methods used in the analysis of the data collected for the research.

3.6 Data Analysis

This section presents the data analysis methods employed within this research. As discussed in this chapter, the research data were both qualitative and quantitative in nature (see section 3.5) and they required a subjective ontological and a pragmatic epistemological philosophy (see sections 3.2.1 and 3.2.2). The quantitative data was analysed using both descriptive and inferential statistics while the qualitative data was analysed with an inductive thematic approach. See Appendix AA for details on the data analysis approach with examples from each research phase.

3.6.1 Theory of Analysis – Quantitative

3.6.1.1 Descriptive Analysis

In this study, some of the data collected through the use of survey in the Advanced Stage, Phase One – Investigating Knowledge Gaps – Consumer Perspective, was analysed through the descriptive statistics. Some of the data collected in Phase Two – Design and Development of the Safe Food Management App and some of the data collected in Phase 3 – Implementing and Evaluating the Safe Food Management App was analysed through descriptive statistics. After the data collection, the data was exported to Microsoft Excel 2010 for initial formatting and then imported into IBM SPSS software version 22.0 for better analysis (see Appendix AA – section 36.1.1.1).

3.6.1.2 Inferential Analysis

In this study, a variety of statistical analyses were conducted to identify patterns in the data and help answer the research questions; this was the scaled simple count method for the best-worst scores. Please see Appendix AA – section 36.1.1.2 for more details.

3.6.2 Theory of Analysis – Qualitative

3.6.2.1 Thematic Analysis

Thematic analysis has helped in creating an understanding of the research area that covers a range of multiple perspectives. This was done through the generation of codes that allowed the unseen to be captured and the unrelated to become related. In this study, the inductive coding approach was used at a sentence level which allowed the essential elements that are associated with research phenomena to be captured. This approach was used to analyse data generated from the Preliminary stage, Phase One: Investigating Knowledge Gaps – Firm Perspective and the data generated from the card sorting

process conducted in Phase Two: Design and Development of the Safe Food Management App. Please see Appendix AA – section 36.1.2.1 for more details.

3.6.3 Analytical Approach

In this sub-section, the research method of analysis is presented. The process of analysis is presented as well as the development of the summary codes. Thereafter, the coding process for all the three stages of the research is presented. Please see Appendix AA – section 36.1.3 for more details on the analytical approach including how the summary codes, open codes, axial codes and themes were derived.

The next section will present the approach utilised in interpreting and discussing the initial findings of the research phases.

3.7 Data Discussion and Interpretation

This describes the approach used in discussing and interpreting the results obtained from the data analysis conducted. The analysis of the research data provided a range of qualitative and quantitative data which was interpreted by the researcher and then discussed in relation to the existing body of literature. The aim of the data interpretation was to examine the outcome from the analysis in relation to the key aspects of the research. This was done by examining the outcome from each of the two methods of analysis discussed in sections 3.6.1 and 3.6.2. The outcomes were examined and interpreted in order to gain insight into how the safe food management app impacts consumer knowledge acquisition, knowledge retention and perceived behavioural change.

The outcomes from the thematic coding conducted in the Preliminary Stage, Phase One – **Investigating Knowledge Gaps – Firm Perspective**, generated insight to the communication gaps between the firm and its consumers which led to the identification of the sources of consumer food safety knowledge gaps. The outcome of this stage led to a focus on consumers by identifying actual consumer knowledge gap areas. The outcome of the descriptive statistics conducted in the **Advanced Stage, Phase One – Investigating Knowledge Gaps – Consumer Perspective**, generated insight into the food safety knowledge gap areas of Australian consumers – safe meat preparation, while answering the first research question. This led to the need to empower consumers to

optimise their knowledge by designing and developing a smartphone app in a way that targets the knowledge gaps that have been identified in the preceding phase. As a baseline, a paper-based tool was developed by the researcher based on one information modality – text, and the textual information was retrieved from relevant government agencies. The smartphone app was developed based on three information modalities – text, pictures and videos (see section 2.3). While the textual information was the same as that of the paper-based tool, the design and development of the app was based on lessons learnt from existing food safety apps. This led to the selection of three existing apps (text-based app, audio-visual app and integrated app) that address the knowledge gap area identified in phase one (safe meat preparation) based on a set of criteria (*see section 3.3.2.2*). Following this, the researcher adopted the health literacy online heuristics framework and combined it with a consumer-based evaluation to holistically assess the usability of these applications, their contexts of use and attributes of the end-users. To achieve this, first, the researcher conducted a heuristic evaluation of all three apps to identify problems based on Monkman and Kushniruk's approach (*see section 3.3.2*). Second, the researcher conducted a consumer based evaluation of all three apps through a scenario based focus group session with nine participants (see section 3.3.2.1). The outcome of the thematic coding conducted in the **Phase Two – Design and Development of the Safe Food Management App**, generated insight into the considerations that should be made when designing and developing tools to specifically address consumers' safe food management knowledge gaps during normal day to day food handling activities. This led to the concept design. The concept design was the basis for the development of the app. The outcome of Phase Two led to the development of the smartphone app and provided the answers to the second research question. Following this, the app was implemented and evaluated in **Phase Three – Evaluating and Implementing the Safe Food Management App**. This phase involved the commencement of the field experiment which comprised of the pre-test, intervention, and three levels of post-test and aimed to determine the impact of the smartphone app on consumer knowledge acquisition, knowledge retention and perceived behavioural change. The outcome of the descriptive statistics conducted in this phase provided the answers to the third research question.

3.8 Chapter Summary

This chapter has presented the philosophical position underpinning this investigation. Given the exploratory nature of this research, the use of a mixed methods approach was well-suited to the subjective ontological and pragmatic epistemological positions underpinning the research. This research comprised of a case study, usability evaluation, field experiment and a three phase data collection strategy.

The research design consisted of three phases. The first phase has two stages while the second phase and third phase have only one stage each. The chapter also discussed the tools and techniques utilised in each of the data collection stages. In the preliminary stage for phase one, semi-structured interviews, document reviews and field notes data was used. In the advanced stage for phase one, survey data was used. In phase two, focus group data was used. In phase three, field experiment data was used.

Data analysis methods were also presented in this chapter. For the preliminary stage, phase one, as well as the phase two, the method of analysis was the development of open and axial codes through thematic analysis. The axial coding process was iterative and final themes were developed. However, for the advanced stage in phase one and phase three, descriptive and inferential statistics, were conducted. The last section of the chapter discussed the process of interpreting and discussing the findings.

The next chapter presents the data analysis and preliminary findings of the Preliminary Stage, Phase One – **Investigating Knowledge Gaps – Firm Perspective** and the Advanced Stage, Phase One - **Investigating Knowledge Gaps – Consumer Perspective**.

CHAPTER FOUR

**DATA ANALYSIS
AND PRELIMINARY
FINDINGS:
INVESTIGATING
KNOWLEDGE GAPS
– PHASE ONE**

4 DATA ANALYSIS AND PRELIMINARY FINDINGS: INVESTIGATING KNOWLEDGE GAPS

4.1 Introduction

This chapter describes the data analysis and initial findings of the Preliminary Stage, Phase One – Firm Perspective and the Advanced Stage, Phase One - Consumer Perspective of the research. Phase one involved identifying knowledge gaps and this was conducted in two stages: the preliminary stage (firm perspective) and the advanced stage (consumer perspective). **First**, the focus of the Preliminary Stage was to determine the role played by a food firm in updating consumers' food safety knowledge during a food recall incident. The data analysis follows the method detailed in section 3. The data collection techniques for this stage included semi-structured interviews (see section 3.5.1) as the primary data source as well as document reviews (see section 3.5.3) and field notes (see section 3.5.4) as secondary data sources. Thematic data analysis was conducted in this stage and it generated twenty-two axial codes and three themes. The themes produced as a result of the inductive coding process are discussed and interpreted while relating it back to phase one of the research. The discussion of the themes identifies the challenges the firm faces which hinder appropriate information sharing between the firm and its consumers, not only during the recall process but on a normal basis. The interpretation shows that post-purchase food safety is largely the responsibility of the consumers while raising questions about how to empower them to optimise their knowledge on safe food management. **Second**, the focus of the Advanced Stage was to identify consumer food safety knowledge gaps. This involved the analysis and discussion of the collected data on three core areas (pre-purchase, post-purchase and information & communication preferences), through an online survey (see section 3.5.6). The data set was analysed using two different approaches. The survey data was statistically analysed in order to create a range of descriptive statistical diagrams and tables for the post-purchase questions. The survey data was also used to generate tables to represent the best-worst scaling attributes selected by the participants for the pre-purchase questions and the IT related questions. The chapter is divided into the following sections:

- Section 4.2 presents the data analysis and preliminary findings of the three themes generated from the Preliminary Stage, Phase One of the research (firm

perspective). The themes are AUTHENTICITY, BRANDING and BUSINESS AGILITY.

- Section 4.3 presents the data analysis and preliminary findings of the Advanced Stage, Phase One of the research (consumer perspective). This involved questions pre-purchase practices, post-purchase practices and information & communication preferences.
- Section 4.4 provides a summary of the chapter.

4.2 Preliminary Stage, Phase One – Firm perspective

The focus of the preliminary stage of phase one was to generate insights into a food recall incident and to explore the role played by a food firm in updating consumers' food safety knowledge during the incident. This aimed to provide insights into the sources of consumer food safety knowledge gaps. First, the context of food recall incidents in Australia is presented. Next, the following sub-sections present and discuss each theme resulting from this stage of the research. As this was a preliminary stage, more emphasis is laid on the discussion and interpretation of findings rather than the presentation of the data, in order not to detract from the focus of the research. This stage generated three themes: AUTHENTICITY, BRANDING and BUSINESS AGILITY.

4.2.1 Food Recall Incidents in Australia

According to Food Standards Australia New Zealand (FSANZ, 2008), a food recall is an “action taken to remove from distribution, sale and consumption, food which may pose a health and safety risk to consumers”. The two levels of recall that occur are trade recalls (not involving consumers) and consumer recalls. Between 2004 and 2014 Australia experienced 600 food recall incidents (ACCC, 2014). Specifically in relation to premium food products, a number of recalls involved detection of contamination with *Escherichia coli*. This contaminant causes a wide range of clinical symptoms, including non-bloody diarrhoea, haemorrhagic colitis, and death (Kousta et al., 2010). During these recall incidents consumers were advised not to eat these products and to return them to the place of purchase for a full refund (ACCC, 2014). Under Australian law, primary producers and processors are required to maintain traceability records to support the easy identification and location of food products should issues, such as chemical

contamination, presence of foreign matter, arise that require product recall (FSANZ, 2008).

An important aspect of any food recall involves information management, as supply chain stakeholders are required to disseminate information to government authorities and the general public in order to reduce the likelihood that affected products are consumed. At the time of writing, this process was conducted through the use of newspapers, television, radio as well as the webpages of the businesses concerned and the Australian Competition and Consumer Commission website. Whilst this “information-push” strategy is relatively effective in ensuring that potentially unsafe products are removed from distribution and retail outlets, the system does not extend to formal actions involving consumption and relies primarily on an implicit ‘hope’ that consumers who have purchased the products will learn of the recall and do not consume the product for which the recall action had been raised. Therefore, current recall response mechanisms do not guarantee a closed loop of communication with all purchasers of a recalled product. This makes it more difficult to accurately bench-mark the effectiveness of the current system and provides little insight into how consumers respond to any information disseminated through these mechanisms. For businesses too, merely performing their legal obligations are unlikely to sufficiently mitigate risks, as the form, nature and information channel used will influence consumer confidence in their products and/or brands in different ways and amongst different types of consumers both during and after the recall (Verbeke and Ward, 2006).

4.2.2 Preliminary Stage, Phase One – Initial Findings

The focus of this stage of the research was to determine the role played by a food firm in updating consumers’ food safety knowledge during a food recall incident. The data collection focused on an Australian food firm that had recently experienced a recall. The detailed discussion of the three themes was supported by the use of interview excerpts, informed by document reviews and field notes as secondary data sources and linked back to the concept of each axial code. At the conclusion of each theme, the association back to the overall intent of this phase was discussed. The analysis of this stage resulted in three themes: AUTHENTICITY, BRANDING and BUSINESS AGILITY.

The initial findings of the Preliminary Stage, Phase One of the research are classified into five key points. First, the firm, which mainly targets a niche market, is interested in

sharing information with its end consumers to facilitate the purchase of their products. Premium consumers are becoming more interested in different types of information such as information relevant to the product, origin and the producer, from the firm. However, after such products have been purchased, little or no information is frequently shared with each consumer of their products on its safe handling and consumption. This is one of the sources of consumer food safety knowledge gaps.

Second, the firm has poor knowledge of how much information should be provided to consumers. On the one hand, the firm believes sending much information is appropriate. However, it is possible to send so much information but still miss the right information consumers actually want. Therefore, the question about the balance of information arises. On the other hand, the firm tends to compromise on the values it claims as well as the values it portrays to the consumers. This results in the firm withholding information from consumers about such compromise and this begins to question the level of transparency the firms has with its consumers.

Third, the firm demonstrates authenticity as a value, which translates to provenance, from the consumers' point of view. The firm has the information that shows how authentic it is but it is limited by the amount of textual information that can be placed on labels. Consequently, the firm decided to exclude the important information altogether because they fail to understand how to convey the possession of that value to the consumer despite the limitation of each information delivery platform. Thus, it became evident that the multiplicity of information delivery channels is important for firms to reach their consumers because of the broad population. The various ways in which consumers have been classified, by this firm, are as follows: Low income earners, middle income earners and high income earners; Young and technology savvy as opposed to the old and paper-based; and Detailed information seekers as opposed to snappy information seekers. However, the firm has poor knowledge of how the classification of consumers influences their reception and utilisation of diverse information forms. Also, the firm has poor knowledge of how much each of the information delivery platforms covers the consumer base.

Fourth, as the firm has recently experienced a recall situation, it became sceptical about updating end consumers regarding the status of their food products after the problem had been rectified because it did not want consumers to have a negative perception.

Therefore, consumers tend to know there is a food recall about a firm but they are usually not informed that the problem has been rectified. Perhaps, this was as a result of the media involvement. This raises questions about the appropriateness of the information delivery channel for sensitive issues as the firm wanted to update the consumers but could not do so. Thus, the appropriateness of information delivery channels can facilitate or impede the enhancement of consumer food safety knowledge.

In addition, it became evident that recovery from a recall situation depends on the brand reputation before the recall occurred, how the recall situation is handled, how information is managed during and after the recall as well as the practices of the supply chain partners.

Fifth, restrictions are not only placed on information through legislations concerning consumer privacy. A firm that desires to share more information about its products can encounter challenges and restrictions even within its supply chain. Regardless of the reason for such restrictions, firms have to abide by it to retain such partners so as not to lose their shelf space. This scenario shows an imbalance of market power – oligopsony. While this is a problem the firm is facing, questions are being raised about the appropriateness of focusing on paper based channels; thus drawing more attention towards the delivery of information through other channels. More importantly, the problem reveals that the firm is not compelled to continually update every consumer of their product; thus the communication gap is not closed even when a food incident arises as the legal obligation of firms does not require such detailed information updates.

The initial findings from this stage are;

- Once consumers have purchased a food product, the firm does not update its consumers on its safe handling and consumption; thus suggesting that the firm is one of the sources of consumer food safety knowledge gaps.
- Maximizing the benefits of diverse information delivery channels by using multiple channels could be beneficial in closing the gaps in consumer food safety knowledge.
- Recall recovery relies on brand reputation, information management, control mechanisms and the practices of supply chain partners.

- During the recovery phase of a recall incident and when the firm makes compromises about its business values, there is a tendency for the firm to withhold information from its consumers; which also suggests that the firm is one of the sources of consumer food safety knowledge gaps.
- More importantly, when a firm is not compelled to close its communication gap with consumers, even when food incidents arise, it becomes more apparent that optimising domestic food safety knowledge post-purchase is largely the responsibility of consumers.

This stage has raised several questions that draw attention to consumers and their knowledge gaps, not only during a food incident; but more broadly, during day to day food management practices. Therefore, it is logical to conduct an investigation on Australian food consumers in order to identify their knowledge gaps on safe food management during their day to day food management practices.

4.3 Advanced Stage, Phase One – Consumer perspective

The focus of the advanced stage of phase one was to generate insights into consumer food safety knowledge gaps. This was done by posing pre-purchase questions, post-purchase questions and questions related to information & communication preferences to the respondents. Please see section 3.5.6.2 for details on how the literature informed the development of the research instrument. The questions were derived from the literature as shown in Table 3-3 and the validity of the research instrument was discussed in section 3.5.6.3. Based on the order of importance, first, the demography of the respondents as well as the descriptive analysis of the screening questions are presented and discussed. This was done to screen out potential respondents, who did not qualify for the survey through the exclusion criteria. Following this, the descriptive analysis of the data regarding the post-purchase questions is presented and discussed. The data was analysed in order to gain an understanding of the food handling practices of the research participants post-purchase, thus providing insights into the existing food safety knowledge gaps. Next, the inferential analysis of the pre-purchase questions using the best-worst scaling discrete choice methodology detailed in section 3.5.6 is presented and discussed. The data was analysed in order to provide an understanding of the attributes that facilitate food, but more specifically meat purchase preferences of the research participants. Finally, the descriptive and inferential analysis of the information

technology related questions is presented and discussed. The data was analysed in order to generate insight into their information and communication preferences for food safety.

4.3.1 Demography of the Respondents

This sub-section presents the demographic data of the participants. All the respondents live in Australia and they are above 18 years of age. 53% of the respondents were females and 46% males. Half of the respondents were above 50 years of age, 31% were between age 30 and 49 while 19% were between 18 and 29 years. In addition, the participants are located in all the states and regions of Australia except Northern Territory as shown in Figure 4-1. About 70% of all the respondents were from the southern states within Australia, where climate, culture, eating and shopping habits are likely to be more similar and relevant to meat than those in tropical region. The educational background of the participants vary but 35% have a Bachelor’s degree or higher, 12% have High School or Year 10 while those who have completed College or Year 12, Certificate and Diploma/Advanced Diploma were 18% each.

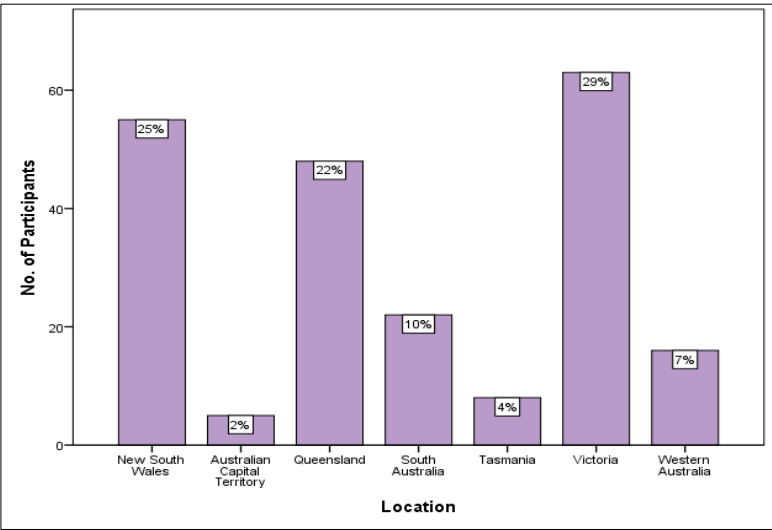


Figure 4-1: Participant Location

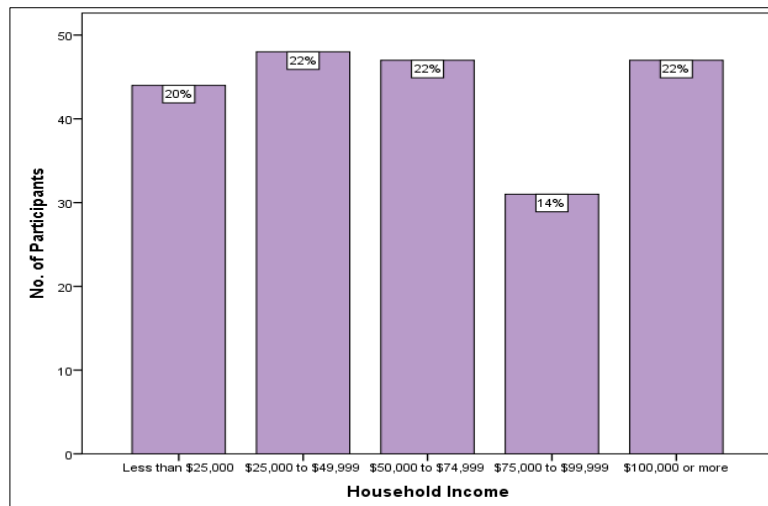


Figure 4-2: Participant Household Income

There is a good spread of income across the respondents as revealed in Figure 4-2. It has been argued that the level of income has some influence on the choices people make but more specifically their shopping habits (Cannuscio et al., 2014). The next sub-section discusses the analysis of the screening questions.

4.3.2 Analysis of Screening Questions

In order to ensure the right respondents indeed filled the survey, several measures were taken. First, the consumer panel utilised for the data collection ensured that participants are living in Australia and they are above 18 years of age. Second, the participants were quizzed about their dietary intake. This is to ensure that survey respondents are not vegans, vegetarians, or only white meat eaters, as the survey will not be related to them. Having screened out potential respondents through the exclusion criteria, 95% of the survey participants who filled the survey have mixed diet which includes red and white meat while others only eat red meat. Third, the participants were also asked about where they shop, as a screening question, in order to ensure that online shoppers were excluded from the survey. This is due to the nature of the questions as it relates to how raw meat is usually handled from the point of purchase to the home. Online shopping defies the purpose for which the survey is intended. The results revealed that 70% of the participants shop for meat products at supermarkets, 29% at fresh food markets or butchers while 1% at delicatessens.

4.3.3 Post Purchase Data Analysis

This section will discuss the analysis of the six elements that were the focus of the post-purchase food handling practice questions presented to the research participants. The six elements are; transport, storage, thawing practices, cooking, reheating leftovers and kitchen hygiene. These elements will be discussed in a logical sequence.

4.3.3.1 Transport

Transport refers to issues around meat handling practices from the point of purchase till the product reaches the consumer's home.

The sub-elements considered here concerns shopping time, meat selection time, meat transportation time, meat packaging in transit. Each of these will now be addressed. **Shopping time** is the length of time it takes each participant to start and finish the process of shopping and payment at the counter within a store.

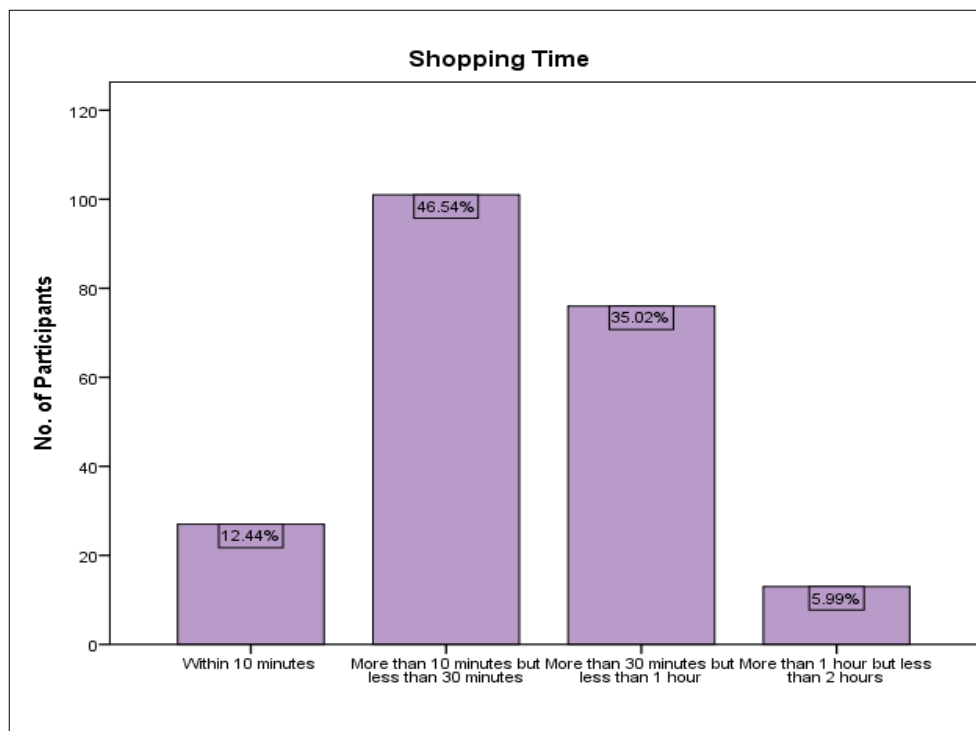


Figure 4-3: Shopping Time

As shown from the Figure 4-3 above, majority of the respondents spend between 10 minutes and 1 hour when shopping for groceries. However, the screening question about where they shop puts this response into a clearer perspective as it is expected that those

who shop from the butchers or delicatessens will spend less time shopping than those who go to the supermarkets. The contingency Tables 4-1 and 4-2 reveal this argument.

Table 4-1: Contingency table for Point of Purchase and Shopping Time

		Where do you usually buy your meat products?			Total
		Fresh food markets / Butchers	Delicatessens	Supermarkets	
When you go into a store to buy groceries and/or fresh meat, how long does it usually take you to complete shopping and payment at the counter?	More than 10 minutes but less than 30 minutes	31	1	69	101
	More than 30 minutes but less than 1 hour	15	0	61	76
	More than 1 hour but less than 2 hours	4	1	8	13
	Within 10 minutes	13	0	14	27
Total		63	2	152	217

Table 4-2: Chi-Square Test of Association for Point of Purchase and Shopping Time

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.776 ^a	6	.015
Likelihood Ratio	12.544	6	.051
Linear-by-Linear Association	4.787	1	.029
N of Valid Cases	217		

a. 5 cells (41.7%) have expected count less than 5. The minimum expected count is .12.

To support this argument with statistical evidence, Pearson's Chi Square test of association reveals, with a p-value of **0.015** that there is a statistically significant association between point of purchase and shopping time.

Meat selection time refers to how soon the research participants typically picks up fresh meat products and puts them in the shopping cart. The findings of the question reveals that 22.58% select them in the beginning, 22.58% in the middle while 34.56% select them at the end of their shopping. 20.28% do not use a consistent approach.

Transportation time is the length of time it usually takes to transport purchased meat products from the point of purchase to the respondent’s home. The findings of the question are shown in Figure 4-4.

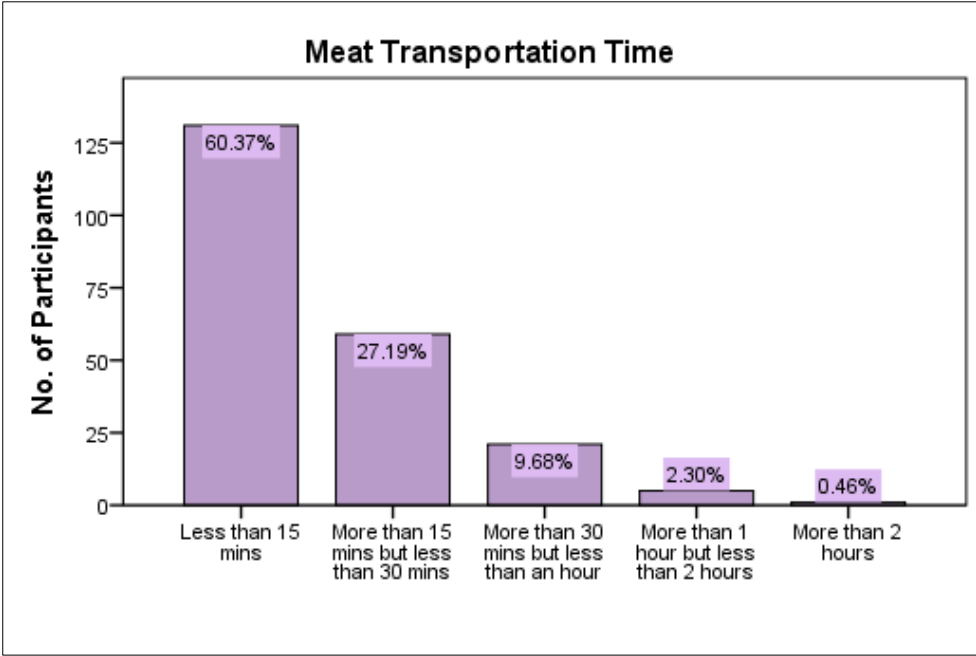


Figure 4-4: Meat Transportation Time

Based on the findings from Figure 4-4, it takes a good percentage of the respondents less than 15 minutes to transport the fresh meat from the place of purchase to their home. Therefore, if such consumers spend up to 1 hour to complete shopping and payment at the counter and they put the meat in the fridge or freezer immediately they get home, there is a high tendency for their meat to still be safe. According to the United States Department of Agriculture, raw meat should not be left at room temperature for more than 1 hour (USDA, 2011). The contingency Tables 4-3 and 4-4 below reveal that majority of the respondents spend less than 30 minutes in transporting their groceries home and 95% spend less than an hour in shopping, thus suggesting that the respondents relatively transports their fresh meat home safely.

Table 4-3: Contingency table for shopping time and transportation time

		How long does it typically take you to transport your meat product from the place of purchase to your home?					Total
		Less than 15 mins	More than 15 mins but less than 30 mins	More than 30 mins but less than an hour	More than 1 hour but less than 2 hours	More than 2 hours	
When you go into a store to buy groceries and/or fresh meat, how long does it usually take you to complete shopping and payment at the counter?	Within 10 minutes	16	10	1	0	0	27
	More than 10 minutes but less than 30 minutes	64	26	10	1	0	101
	More than 30 minutes but less than 1 hour	45	19	8	4	0	76
	More than 1 hour but less than 2 hours	6	4	2	0	1	13
	Total	131	59	21	5	1	217

Table 4-4: Chi-square test of association for shopping time and transportation time

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	23.598 ^a	12	.023
Likelihood Ratio	14.068	12	.296
Linear-by-Linear Association	.506	1	.477
N of Valid Cases	217		

a. 11 cells (55.0%) have expected count less than 5. The minimum expected count is .06.

To support the prior argument with statistical evidence, Pearson's Chi Square test of association reveals, with a p-value of **0.023** that there is a statistically significant association between transportation time and shopping time.

Meat packaging in transit refers to how the fresh meat is packaged for the journey between the place of purchase to the participant's home. For this question, 48.85% use a supermarket shopping bag, 33.18% use an insulated shopping bag while 17.97% use their own non-insulated bag. Whilst the findings reveal that 33% of the respondents use an insulated shopping bag to package their fresh meat products when transporting it from the place of purchase to their homes, the contingency Tables 4-5 and 4-6 provide more detailed information about the importance of the use of an insulated bag relative to the time it takes to transport the meat product from the point of purchase to the home.

Table 4-5: Contingency table for transportation time and meat packaging

		Apart from the package that comes with meat products, which of the following best describes the way you usually package your fresh meat for the journey between the place of purchase to your home?			Total
		I use an insulated bag or box	I use my own non-insulated bag	I use a supermarket shopping bag	
How long does it typically take you to transport your meat product from the place of purchase to your home?	Less than 15 mins	37	18	76	131
	More than 15 mins but less than 30 mins	23	11	25	59
	More than 30 mins but less than an hour	8	9	4	21
	More than 1 hour but less than 2 hours	3	1	1	5
	More than 2 hours	1	0	0	1
Total		72	39	106	217

Table 4-6: Chi-Square Test of Association for transportation time and meat packaging

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	20.809 ^a	8	.008
Likelihood Ratio	20.179	8	.010
Linear-by-Linear Association	11.007	1	.001
N of Valid Cases	217		

a. 7 cells (46.7%) have expected count less than 5. The minimum expected count is .18.

From the contingency Table 4-5 above, the findings reveal that about 66% of the respondents who spend more than 1 hour transporting their fresh meat use an insulated shopping bag, thus suggesting that they have an understanding of the temperature control requirements of fresh meat products. In consonance with this, Pearson's Chi Square test of association reveals, with a p-value of **0.008** that there is a statistically significant association between transportation time and meat packaging.

Therefore, the findings for this sub-section reveals that the respondents have a relatively good understanding of how fresh meat should be transported safely between point of purchase and home.

4.3.3.2 Storage

Storage refers to issues around how fresh meat is stored for later preparation for consumption.

The sub-elements considered here concerns preservation mode, fridge storage system, packaging for fridge storage, length of time in fridge storage. Each of these will now be addressed.

Preservation mode refers to how the respondents usually preserve the purchased fresh meat if it will not be cooked on the same day. This is shown in Figure 4-5.

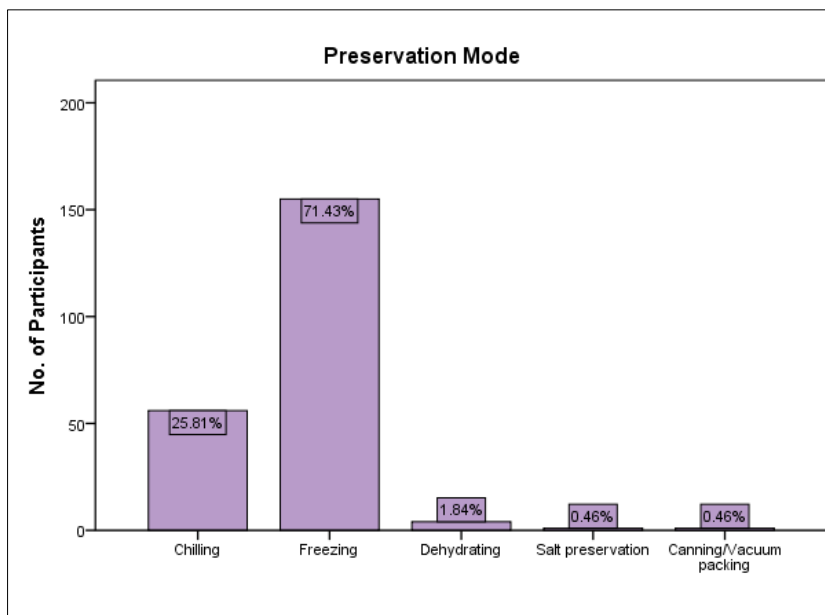


Figure 4-5: Preservation Mode

The assumption made is here that there is a low tendency for fresh meat being placed in the freezer to become unsafe. Therefore, it is believed that 71% of the respondents store their meat safely in the freezer. However, for the respondents who store their meat in the fridge, further questions can indeed reveal the presence or absence of unsafe meat handling practices.

Fridge storage system is concerned with the specific location where fresh meat is typically placed in the fridge by the respondents. For this question, 16.1% have no specific storage system, 21.4% place it with other meat and seafood products, 28.6%

place it randomly while 33.9% place it in a separate compartment. According to Food Standards Australia New Zealand, it is important to keep raw and cooked foods in separate compartments to avoid the risk of cross contamination (FSANZ, 2016). The findings here show that about 45% of the respondents either have no specific storage system or place the fresh meat randomly in the fridge without careful thoughts on where it is placed while about 55% have a relatively good understanding of where fresh meat should be placed in the fridge.

Packaging for fridge storage refers to how the respondents usually package their fresh meat products before placing them in the fridge. This is shown in Figure 4-6.

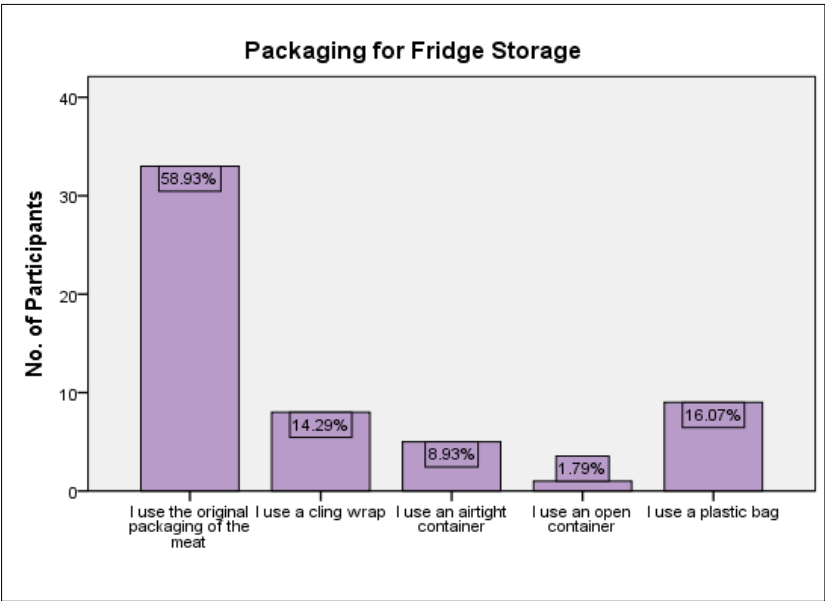


Figure 4-6: Packaging for Fridge Storage

Findings from Figure 4-6 indicate that about 72% of the respondents who chill their meat, do not use an airtight container/wrap to package the fresh meat before placing it in the fridge. 59% of those respondents indicate that they use the original packaging of the meat which may be damaged thus resulting in leaks that may cause other food items in the fridge to be unsafe. Figure 4-7 provides more insight into packaging for fridge storage and fridge storage system.

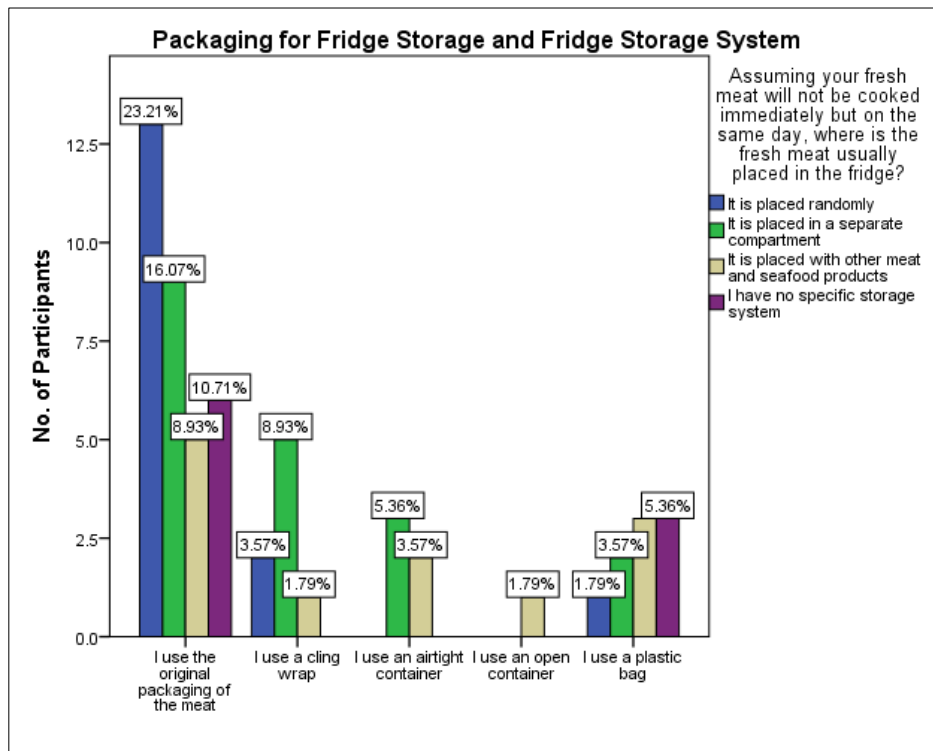


Figure 4-7: Packaging for fridge storage and fridge storage system

The findings from Figure 4-7 reveals that about 57% of those who chill their meat and use its original packaging either place it randomly in the fridge or have no specific storage system, thus portraying limited understanding of how meat should be stored safely.

Length of time in fridge storage refers to how long the respondents typically store fresh meat products in the refrigerator. This is shown in Figure 4-8.

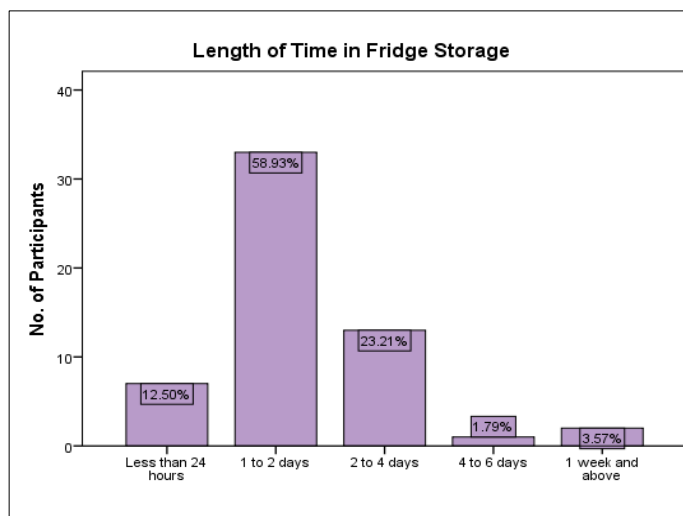


Figure 4-8: Length of Time in Fridge Storage

The findings in Figure 4-8 indicate that about 71% of the respondents store their fresh meat products in fridges within the recommended length of time specified by food safety experts.

Therefore, this sub-section indicates that 72% of the respondents who chill their meat do not know how to package their meat for fridge storage while 44% do not know where to place it in the fridge. The findings here thus suggests that respondents who prefer to chill their fresh meat products in the refrigerator have an average level of knowledge on safe meat storage practices but still require a better understanding of how the meat should be packaged for storage and where the meat should be placed within the fridge.

4.3.3.3 Thawing Practices

Thawing practices is concerned with how frozen meat is being handled during the process of defrosting.

The sub-elements considered here concerns thawing procedure, thawing time length (fridge, room temperature, cold water), package for thawing in cold water, post-thaw handling and post-thaw (time before cooking). Each of these will now be addressed.

Thawing procedure refers to how the respondents typically thaw an average steak-sized piece of frozen raw meat such as beef. This is shown in Figure 4-9.

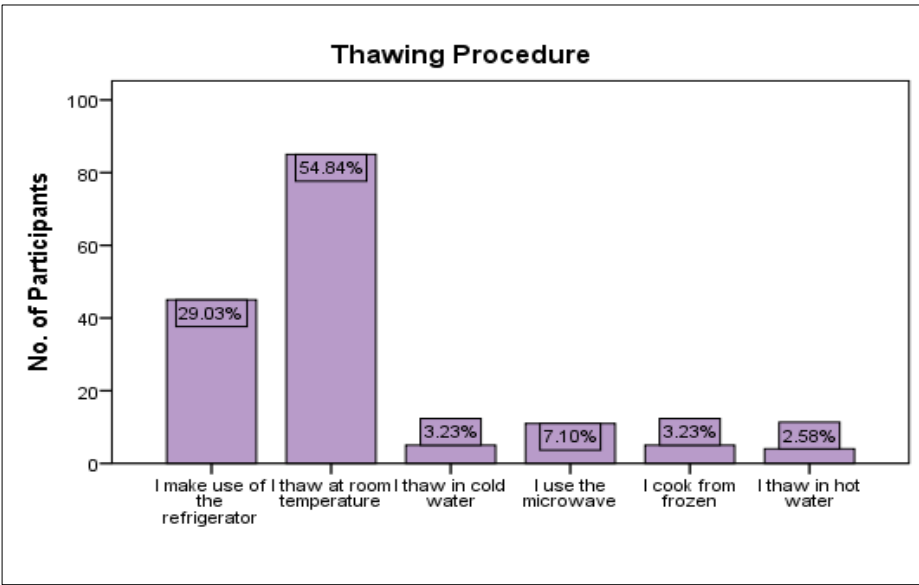


Figure 4-9: Thawing procedure

According to the United States Department of Agriculture's (USDA's) food safety and inspection service, meat thawed in the refrigerator or cooked from frozen is deemed safe but it takes longer time (USDA, 2013a). Therefore, it does require some prior planning. The finding from Figure 4-5 and Figure 4-9 indicates that only 32% of the respondents, who freeze their meat, directly thaw their meat products through the most recommended methods. One of these thawing methods involves the use of refrigerators.

Thawing time length using refrigerator refers to the length of time it took respondents to thaw an average steak-sized piece of frozen raw meat in the refrigerator. It took 28.9% of the participants less than 6 hours, 35.6% more than 6 hours but less than 12 hours, 33.3% more than 12 hours but less than 1 day and only 2.2% more than 1 day but less than 2 days.

Furthermore, findings from Figure 4-9 reveal that at least 2.6% of the respondents, who freeze their meat, do not thaw their frozen meat safely as meat thawed in hot water is deemed unsafe and may lead to foodborne illness. Furthermore, meat thawed at room temperature, through the microwave or in cold water requires special attention and care to ensure it is safe. Therefore, to safely thaw meat at room temperature, the USDA's food safety and inspection service stated that meat should not be left at room temperature for more than 2 hours (USDA, 2013a). Thus, further analysis is required to investigate whether meat thawed at room temperature, through the microwave and in cold water by the respondents are safe.

Thawing time length at room temperature shows the length of time it takes respondents to thaw an average steak-sized piece of frozen raw meat at room temperature. It took 20% of the participants less than 2 hours, 43.5% more than 2 hours but less than 4 hours, 32.9% more than 4 hours but less than 8 hours and about 3.5% more than 8 hours but less than 10 hours. Thus, the findings indicate that 80% of the respondents, who freeze their meat and thaw it at room temperature, do so in an unsafe manner as they leave it on the counter for more than 2 hours. Therefore, about 44% of all the respondents, who freeze their meat, thaw it at room temperature in an unsafe manner. To investigate whether meat thawed in cold water, by the respondents, is safe; further analysis had to be carried out on the length of time it took to thaw but more importantly how the meat was packaged.

Thawing time length in cold water refers to the length of time it takes respondents to thaw an average steak-sized piece of frozen raw meat in cold water. It took 60% more than 30 minutes but less than 1 hour to thaw while it took 40% more than 1 hour but less than 2 hours to thaw.

Package for thawing in cold water refers to how the meat is prepared for defrosting before placing it in cold water. 60% place the meat along with its original packaging in water, 20% remove the meat from its original packaging and place it in water while 20% place the meat along with its original packaging in a leak proof bag before placing it in water. The findings indicate that 80% of the respondents, who freeze their meat and thaw it meat in cold water, do so in an unsafe manner as they do not adequately protect the meat from bacteria from the air or surrounding environment. Therefore, about 2.6% of all the respondents, who freeze their meat, thaw it in cold water in an unsafe manner.

Post-thaw handling is concerned with how the respondents manage meat products that have undergone the thawing process. This seeks to know three things: whether the meat is cooked immediately or not; how long it usually takes before it is cooked and whether it is cooked at all or not before being placed in the fridge again. Figure 4-10 shows the post-thaw handling practices of the respondents.

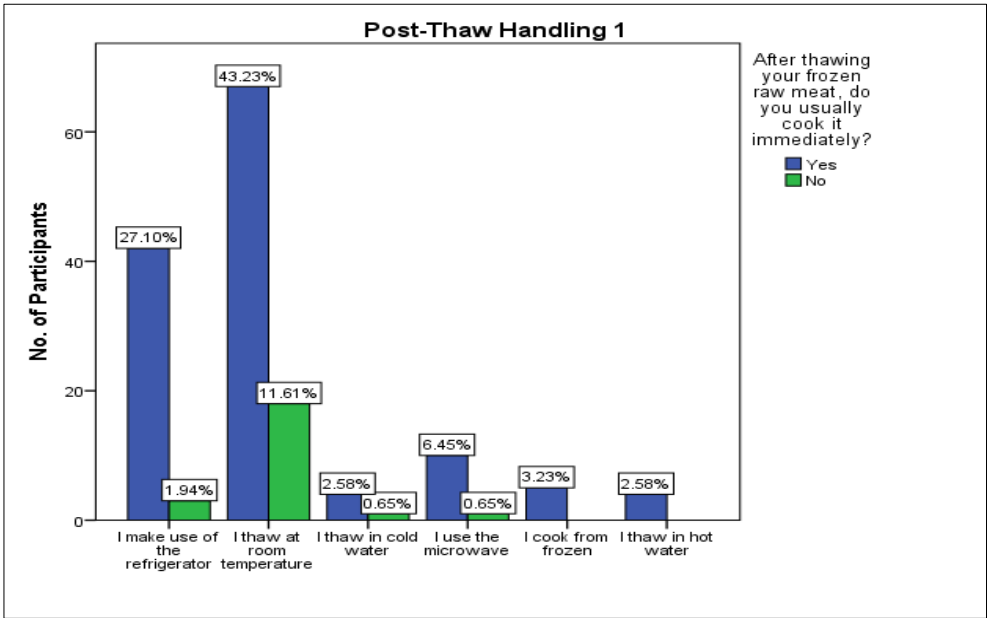


Figure 4-10: Post-thaw handling 1

The findings in Figure 4-10 indicate that only 0.7% of all the respondents, who use the microwave to thaw, do so in an unsafe manner. This is based on the statement by the USDA’s food safety and inspection service that says “partially cooked food is not recommended because any bacteria present wouldn't have been destroyed and, indeed, the food may have reached optimal temperatures for bacteria to grow” (USDA, 2013a). To investigate whether all those who do not cook their meat immediately are risking bacteria contamination, further analysis is conducted. Figure 4-11 shows the length of time it takes the respondents to start cooking the thawed meat.

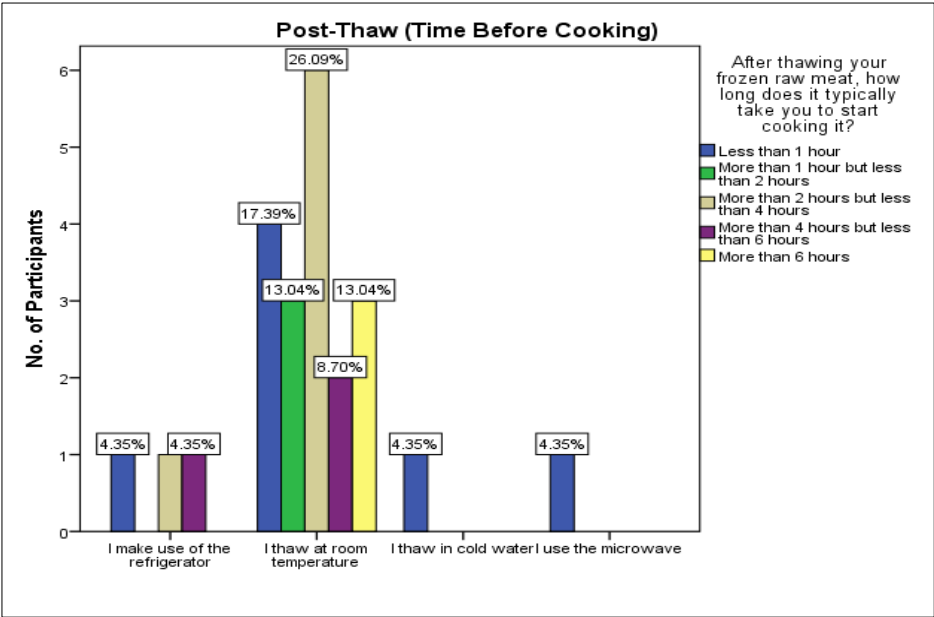


Figure 4-11: Post-thaw (time before cooking)

The findings in Figure 4-11 indicates that about 61% of all the respondents who freeze their meat and thaw it at room temperature, do not cook it immediately; thus exposing the meat to bacteria contamination. According to the USDA, meat thawed in cold water, in the microwave or at room temperature should be cooked before placing it back in the fridge. Figure 4-12 shows another set of post-thaw handling practices of the respondents.

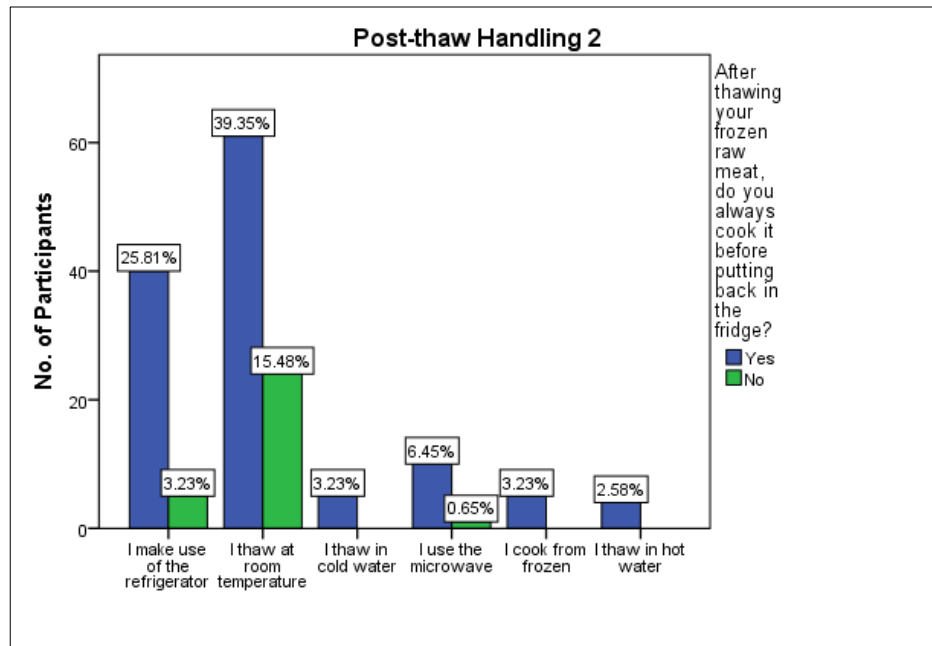


Figure 4-12: Post-thaw handling 2

The findings from Figure 4-12 indicates that a large percentage of respondents who thaw at room temperature, do not always cook it before refreezing, thus increasing the chances of bacterial contamination.

Therefore, the results from Figure 4-9 to Figure 4-12 indicates that about 47% of all the respondents, who freeze and thaw their meat, do so in an unsafe manner; thus indicating that there are knowledge gaps in this area. However, the food handling practice in this sub-section that is most concerning is the thawing of meat products at room temperature.

4.3.3.4 Cooking

Cooking involves issues related to ensuring that the preparation of meat products is carried out in a safe manner.

The sub-elements considered here concerns doneness assessment, doneness preference, safe cooking temperature (rare, medium rare, medium, medium well, well done), frying time (rare, medium rare, medium, medium well, well done). Each of these will now be addressed.

Doneness assessment refers to how the respondents typically assess how well-cooked their meat is, during the cooking process. Figure 4-13 shows the ways in which the respondents evaluate meat doneness.

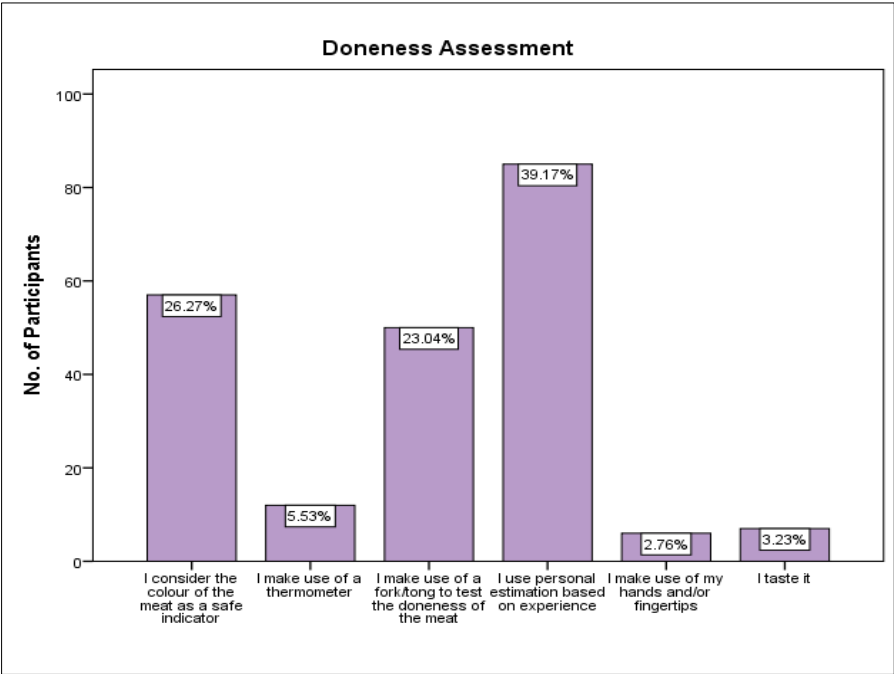


Figure 4-13: Doneness assessment

The results in Figure 4-13 shows that about 94% of all the respondents do not utilise the recommended method of assessing how well cooked meat is. According to the New South Wales Food Authority (NSWFA, 2015a), the doneness of meat should be assessed using a thermometer in order to ensure it is safe. Their argument is based on the fact that colours and other subjective methods of evaluation cannot be relied upon as they differ from person to person.

Doneness preference refers to how well-cooked the respondents prefer their meat. Their response to this question determines the other questions being posed to them. The findings here reveal that 3.7% prefer rare meat, 25.8% prefer medium rare, 26.7% prefer medium, 20.3% medium well while 23.5% prefer well done meat.

Safe cooking temperature is a question posed to determine the respondent’s idea of the appropriate cooking temperature of meat from the respondents who make use of a thermometer to assess the doneness of their meat. Based on the findings from Figure 4-13, only 5.5% of all the respondents make use of thermometer and out of these, none of

them have a preference for rare meat or well cooked meat. Therefore, the following analysis will be based on findings on the safe cooking temperatures for medium rare, medium cooked and medium well meat. Figure 4-14 shows the results of the safe cooking temperature for medium rare meat lovers.

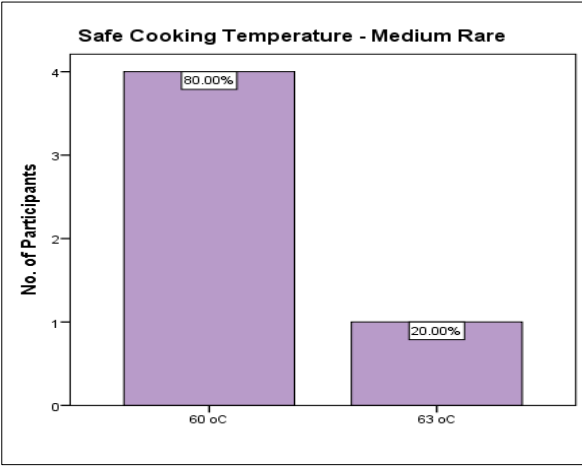


Figure 4-14: Safe cooking temperatures – medium rare

The result here indicates that about 80% of all the respondents, who use thermometers, cook an average sized piece of medium rare meat at 60° C, which is not the recommended safe cooking temperature thus making the meat undercooked. According to the New South Wales Food Authority (NSWFA, 2015a), the recommended temperature is 63° C. Figure 4-15 shows the results of the safe cooking temperature for medium cooked meat lovers.

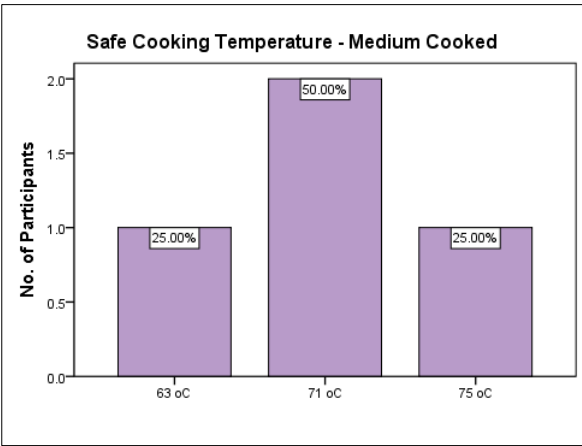


Figure 4-15: Safe cooking temperatures – medium cooked

The findings indicate that about 50% of all the respondents, who use thermometers, cook an average sized piece of medium cooked meat at 71° C, which is the recommended safe

cooking temperature according to the New South Wales Food Authority. Figure 4-16 shows the result of the safe cooking temperature for medium well meat lovers.

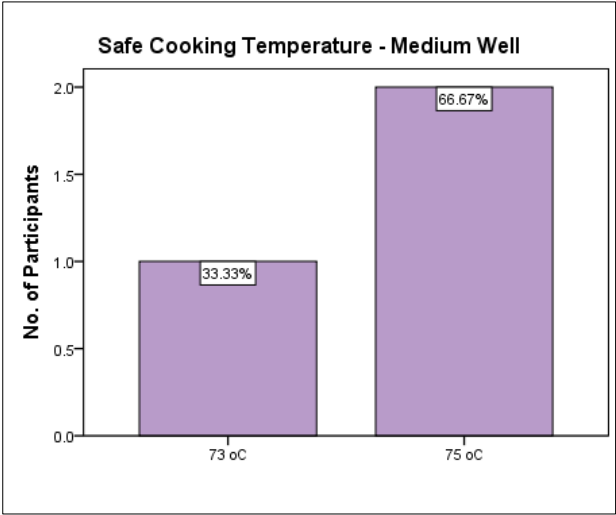


Figure 4-16: Safe cooking temperatures – medium well

The result in Figure 4-16 indicates that 100% of all the respondents, who use thermometers, cook an average sized piece of medium well meat at either 73° C or 75° C, which are not the recommended safe cooking temperature thus making the meat undercooked. According to the New South Wales Food Authority (NSWFA, 2015a), the recommended temperature is 77° C.

Frying time refers to how long it typically takes the respondents to cook (pan-fry) a 3.5cm thick fillet beef steak in total based on their preference of doneness. Figure 4-17 shows how long it takes respondents to cook a rare piece of meat.

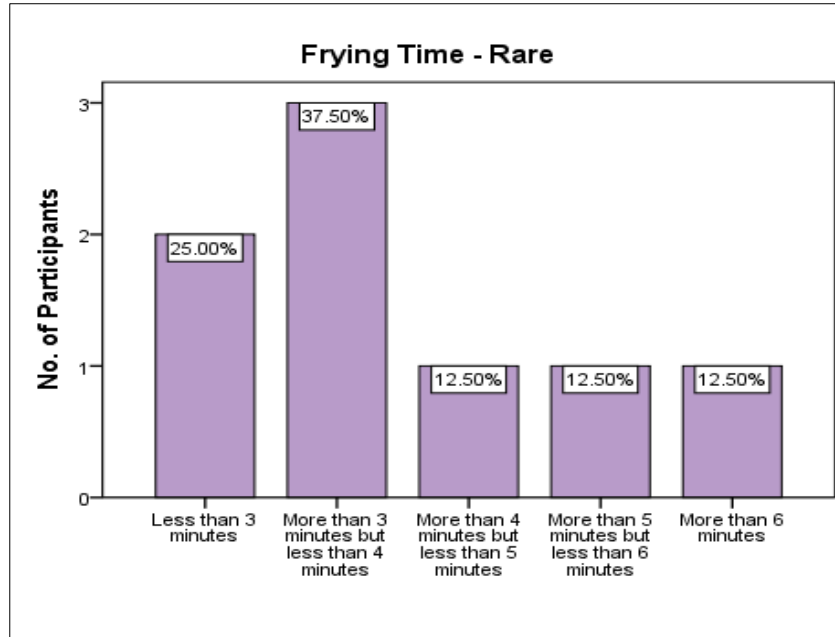


Figure 4-17: Frying time - rare

The findings in Figure 4-17 indicates that about 63% of all the respondents, who prefer rare pieces of meat, undercook it, as they only cook it for less than 4 minutes which is below the recommended safe cooking time. The recommended safe cooking time for the specified meat is more than 4 minutes but less than 5 minutes (MLA, 2015). In the following Figure 4-18, the length of time it takes respondents to cook a medium rare piece of meat is shown.

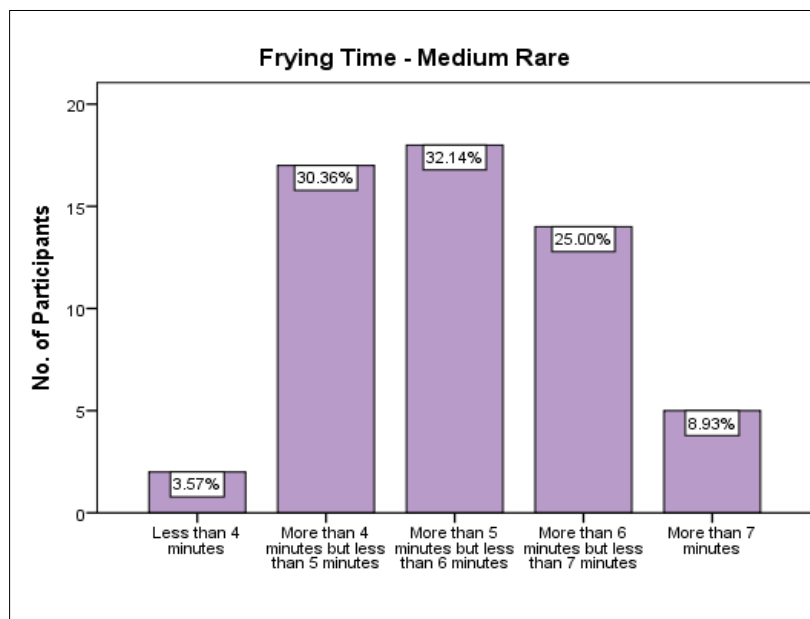


Figure 4-18: Frying time – medium rare

The results above show that about 66% of all the respondents, who prefer medium rare pieces of meat, undercook it, as they only cook it for less than 6 minutes which is below the recommended safe cooking time. The recommended safe cooking time for the specified meat is more than 6 minutes but less than 7 minutes (USDA, 2015, Hardwick, 2014). In Figure 4-19, the length of time it takes respondents to cook a medium cooked piece of meat is shown.

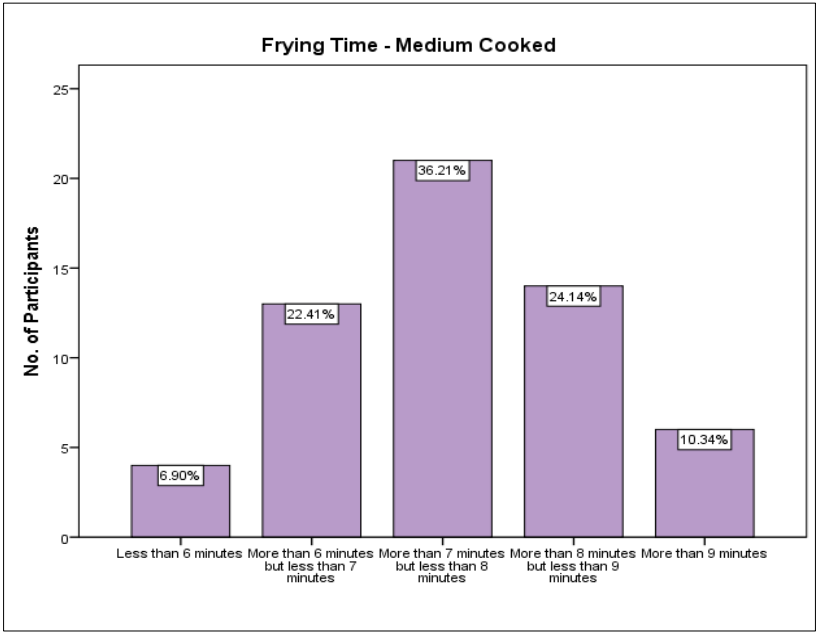


Figure 4-19: Frying time – medium cooked

The results shown in Figure 4-20 reveals that about 66% of all the respondents, who prefer medium cooked pieces of meat, undercook it, as they only cook it for less than 8 minutes which is below the recommended safe cooking time. The recommended safe cooking time for the specified meat is more than 8 minutes but less than 9 minutes (Hardwick, 2014, USDA, 2015). In the following Figure 4-20, the length of time it takes respondents to cook a medium well piece of meat is shown.

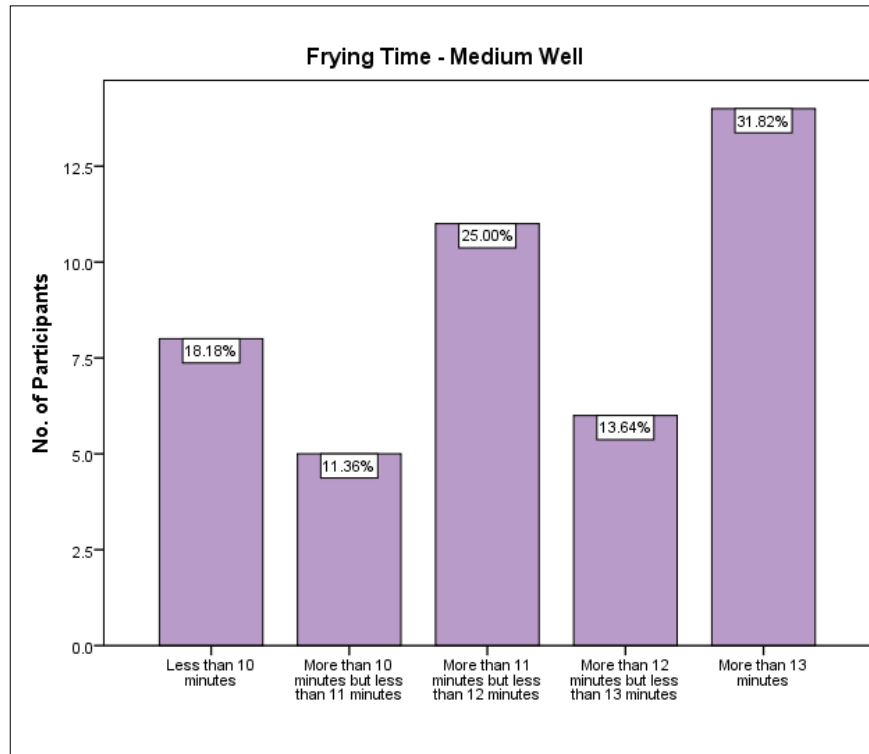


Figure 4-20: Frying time – medium well

The findings in Figure 4-20 indicates that only about 18% of all the respondents, who prefer medium well pieces of meat, undercook it, as they only cook it for less than 10 minutes which is below the recommended safe cooking time. The recommended safe cooking time for the specified meat is more than 10 minutes but less than 11 minutes (USDA, 2015, Hardwick, 2014). In the following Figure 4-21, the length of time it takes respondents to cook a well done piece of meat is shown.

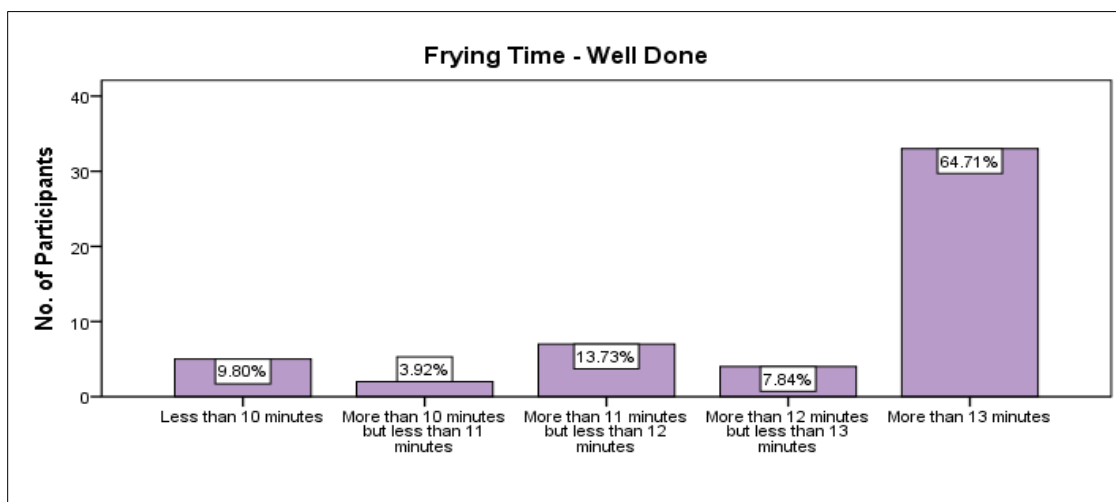


Figure 4-21: Frying time – well done

The findings in Figure 4-21 indicates that only about 27% of all the respondents who prefer well done pieces of meat undercook it, as they only cook it for less than 12 minutes which is below the recommended safe cooking time. The recommended safe cooking time for the specified meat is more than 12 minutes but less than 13 minutes (USDA, 2015, Hardwick, 2014). Therefore, based on findings from Figures 4-17 to 4-21, 48% of all the respondents do not know how to safely cook meat to their preferred level of doneness. Table 4-7 shows a summary of findings on frying time.

Table 4-7: Summary of findings on frying time

Preference	Unsafe	Safe	Total
Rare	63%	37%	100%
Medium Rare	66%	34%	100%
Medium	66%	34%	100%
Medium Well	18%	82%	100%
Well Cooked	27%	73%	100%
Total	240%	260%	500%

Therefore, the findings within this sub-section indicates that 94% of all the respondents do not utilise the recommended method of assessing how well cooked meat is while almost half of all the respondents have a limited understanding of how long to cook meat to their preferred level of doneness but in a safe manner. This suggests that the meat cooking practice that is most concerning is the assessment of how well cooked the meat it.

4.3.3.5 Reheating Leftovers

Reheating leftovers is concerned with the management and handling of leftover meat before storage till its actual consumption.

The sub-elements considered here concerns cooling leftovers pre-storage, leftover storage mode, leftover storage system, packaging for leftover storage, leftover storage time length, leftover reheating and time to consume post-reheat. However, respondents were only asked the questions in the preceding sub-elements if they confirm a usual possession of leftover cooked meat in their kitchen. Hence, there is a preceding sub-element known as leftover possession. Each of the sub-elements will now be addressed.

Leftover possession aims to understand whether respondents usually possess leftover cooked meat in their kitchen. 46% of the respondents have leftover cooked meat while 54% do not. Therefore, the following sub-elements are focused on only these respondents. The next sub-element to be discussed is cooling leftovers pre-storage.

Cooling leftovers pre-storage refers to how respondents typically cool leftover cooked meat prior to storage. Figure 4-22 reveals the results of cooling leftovers pre-storage.

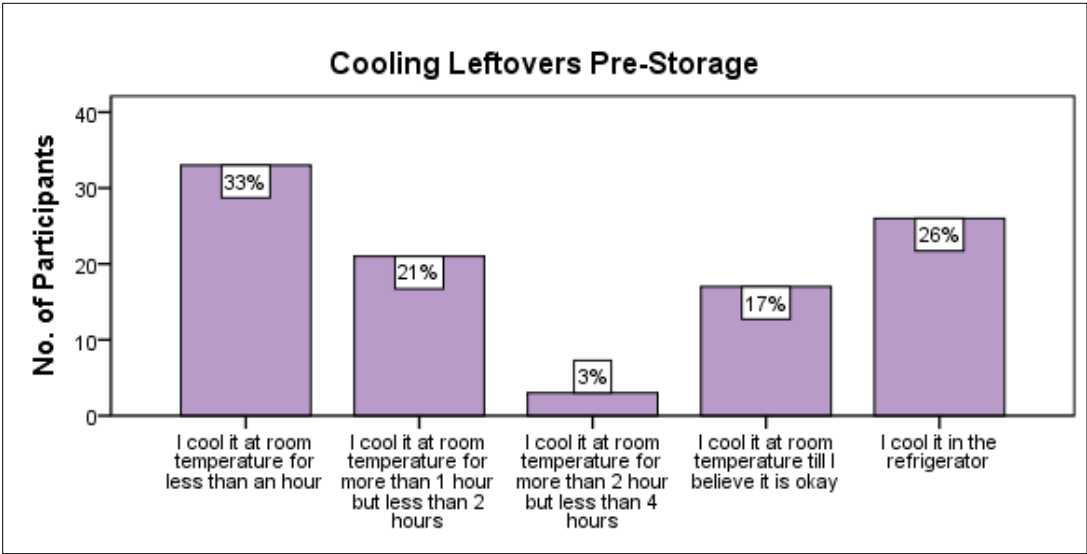


Figure 4-22: Cooling leftovers pre-storage

The findings in Figure 4-22 reveal that about 80% of all the respondents, who usually have leftover cooked meat in their possession safely cool the leftovers prior to storage. The next sub-element to be discussed is leftover storage mode.

Leftover storage mode determines how the respondents usually store the leftover cooked meat in their possession. Placing leftovers on the kitchen counter or storing it at room temperature are potentially unsafe food handling practices. 89.9% chill it in the refrigerator, 5.1% freeze it, 4% leave it on the counter and 1% leave it at room temperature.

The findings show that about 90% of all the respondents, who usually have leftover cooked meat in their possession, store it by placing it in the refrigerator. This has the potential to make the food unsafe if the storage process is not handled properly. To investigate whether these respondents understand safe leftover handling for storage in

the fridge, further analysis was conducted. The next sub-element to be discussed is leftover storage system.

Leftover storage system is concerned with the considerations respondents usually make before placing the leftover cooked meat in any location in the fridge. This question is specifically posed to those who usually have leftover cooked meat in their possession and regularly stores it in the refrigerator. Figure 4-23 reveals the result of leftover storage system. The question specifically asks which of the food items the respondents will typically place next to the cooked meat in the fridge.

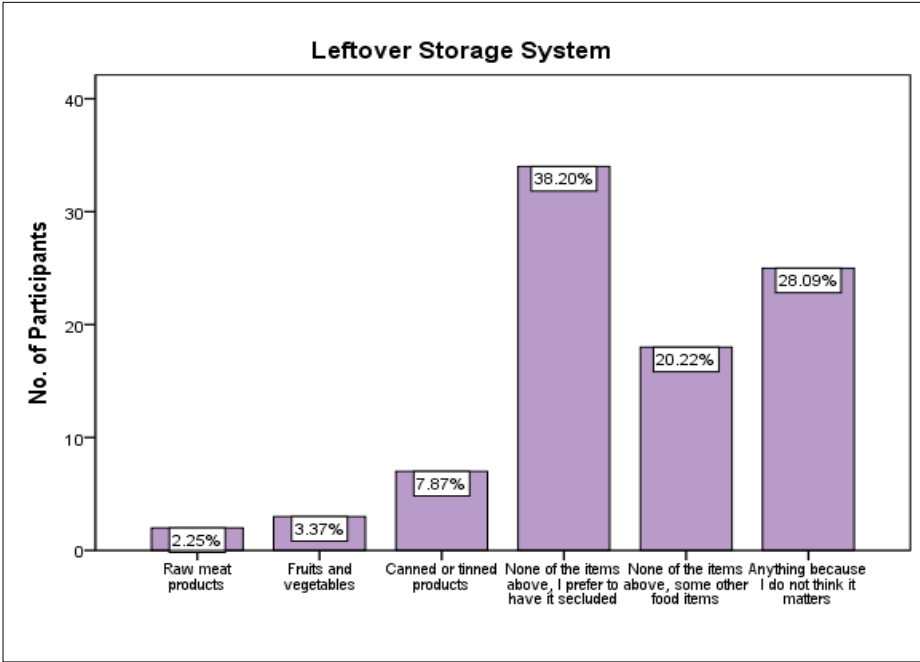


Figure 4-23: Leftover storage system

The findings in Figure 4-23 reveal that about 70% of all the respondents, who usually have leftover cooked meat in their possession and store them in the fridge, carefully consider where the cooked leftover meat is placed in the refrigerator. The next sub-element to be discussed is packaging for leftover storage.

Packaging for leftover storage provides insight into how the respondents usually prepare their leftover cooked meat for storage in the fridge. This question is specifically posed to those who usually have leftover cooked meat in their possession and regularly store it in the refrigerator. The Figure 4-24 reveals the result of packaging for leftover storage.

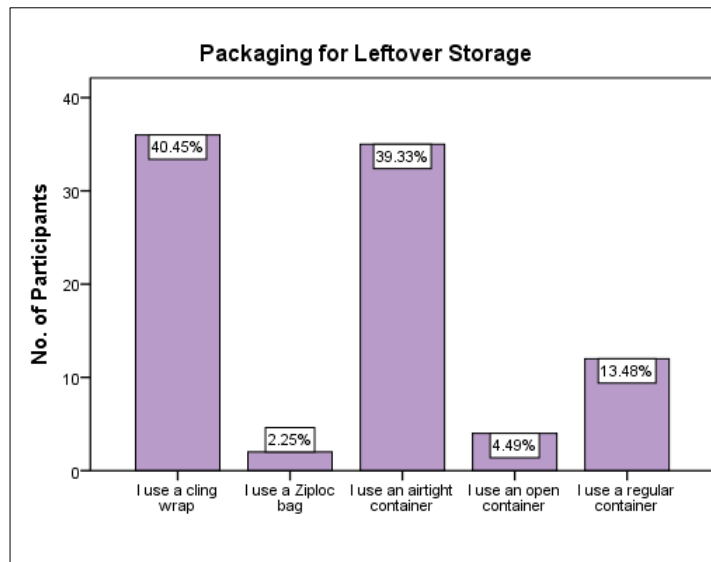


Figure 4-24: Packaging for leftover storage

The findings in Figure 4-24 reveals that about 82% of all the respondents, who usually have leftover cooked meat in their possession and store them in the fridge, carefully package the cooked leftover meat before placing it in the refrigerator. The next sub-element to be discussed is leftover storage time length.

Leftover storage time length describes how long respondents typically store leftover cooked meat in the refrigerator. This question is specifically posed to those who usually have leftover cooked meat in their possession and regularly store it in the refrigerator. Figure 4-25 reveals the result of leftover storage time length.

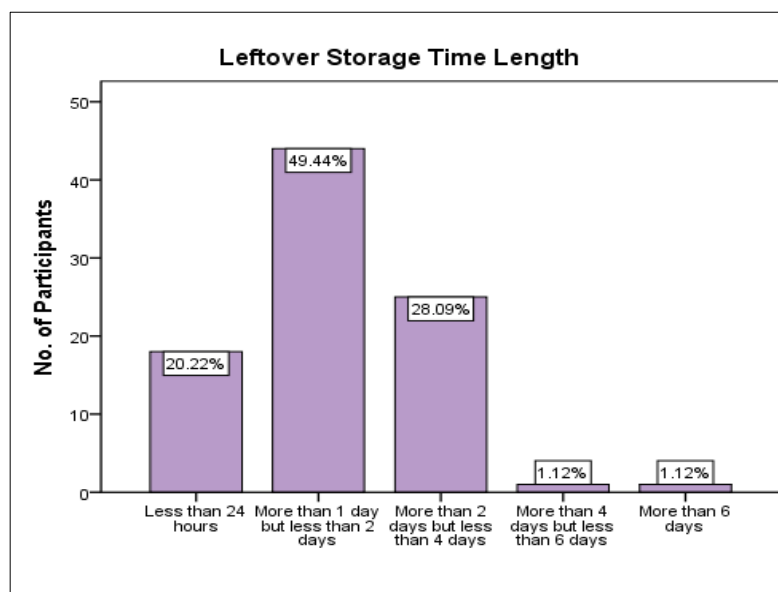


Figure 4-25: Leftover storage time length

The findings show that about 98% of all the respondents, who usually have leftover cooked meat in their possession and store them in the fridge, store it within the recommended time limit of less than 4 days for cooked meat storage in the refrigerator (USDA, 2013b, FSANZ, 2015). The next sub-element to be discussed is reheating leftovers.

Leftover reheating is concerned with how much the respondents usually reheat leftover meat. This question is specifically posed to those who usually have leftover cooked meat in their possession. 50% of the participants reheat leftover meat until it is steaming hot, 15% reheat leftover meat until it is warm, 7% do not reheat leftover meat while 28% reheat leftover meat until they believe it is okay. The findings show that only half of all the respondents, who usually have leftover cooked meat in their possession, reheat it up to the recommended heating level for leftover meat (USDA, 2013b, FSANZ, 2015). The next sub-element to be discussed is time to consume post-reheat.

Time to consume post-reheat determines how long it typically takes the respondents to start eating the leftover meat after it has been reheated. This question is specifically posed to those who usually have leftover cooked meat in their possession and they do reheat it. Figure 4-26 reveals the result of time to consume post-reheat.

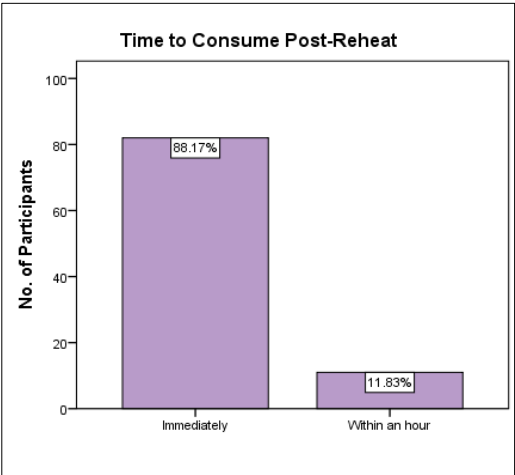


Figure 4-26: Time to consume post-reheat

The findings in Figure 4-26 indicates that about 88% of all the respondents, who usually have leftover cooked meat in their possession and indeed reheat it, usually consume the

reheated food immediately to prevent bacteria from multiplying which could make the food unsafe (FSANZ, 2015).

Therefore, the findings within this sub-section suggests that over 80% of all the respondents who usually possess leftover cooked meat in their kitchen, safely manages it and all its associated processes prior to storage till its actual consumption. This indicates that many of the respondents have a relatively good level of understanding safe food management with reference to reheating leftover cooked meat.

4.3.3.6 Kitchen Hygiene

Kitchen hygiene is concerned with meat handling practices during the process of food preparation within the consumer's home.

The sub-elements considered here concerns glove users (simultaneous cooking management and glove management) and non-glove users (simultaneous cooking management, handwashing frequency, handwashing process and hand drying). Based on the nature of the aforementioned sub-elements, there is a preceding sub-element known as simultaneous cooking. Each of the sub-elements will now be addressed.

Glove user determines if the respondents usually wear gloves when preparing fresh meat. The findings reveal that 90.8% of the participants do not use gloves while only 9.2% use it. To determine whether this can make the food being prepared potentially unsafe, further analysis has to be conducted. The next sub-element to be discussed is simultaneous cooking.

Simultaneous cooking investigates whether the respondents usually cook other food products such as vegetables at the same time when fresh meat is being prepared. The findings indicate that about 80% of all the respondents usually cook other food products such as vegetables at the same time when fresh meat is being prepared while 20% do not. This has the tendency to result into potentially unsafe food, if the process is not well managed. Tables 4-8 and 4-9 show a clearer perspective of the inter-relationship between the 2 variables (glove user and simultaneous cooking).

Table 4-8: Glove user and simultaneous cooking

		When preparing fresh meat, do you usually cook other food products such as vegetables at the same time?		Total
		Yes	No	
When preparing fresh meat, do you usually wear gloves?	Yes	13	7	20
	No	161	36	197
Total		174	43	217

Table 4-9: Chi square test of association for glove user and simultaneous cooking

Chi-Square Tests					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.197 ^a	1	.074		
Continuity Correction ^b	2.231	1	.135		
Likelihood Ratio	2.806	1	.094		
Fisher's Exact Test				.083	.073
Linear-by-Linear Association	3.182	1	.074		
N of Valid Cases	217				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 3.96.

b. Computed only for a 2x2 table

The findings of the contingency Table 4.8 indicates that regardless of the use or lack of the use of gloves, many of the respondents tend to simultaneously cook other food products such as vegetables at the same time when fresh meat is being prepared. However, Pearson's Chi Square test of association reveals, with a p-value of **0.074** that there is a statistically significant association between the variables glove user and simultaneous cooking. The next sub-element to be discussed is glove user - simultaneous cooking management.

Glove user - simultaneous cooking management determines how the respondents, who use gloves, typically manage the simultaneous preparation of fresh meat and vegetables. This question is specifically posed to those who wear gloves and do simultaneous cooking. Figure 4-27 reveals the result of glove user - simultaneous cooking management.

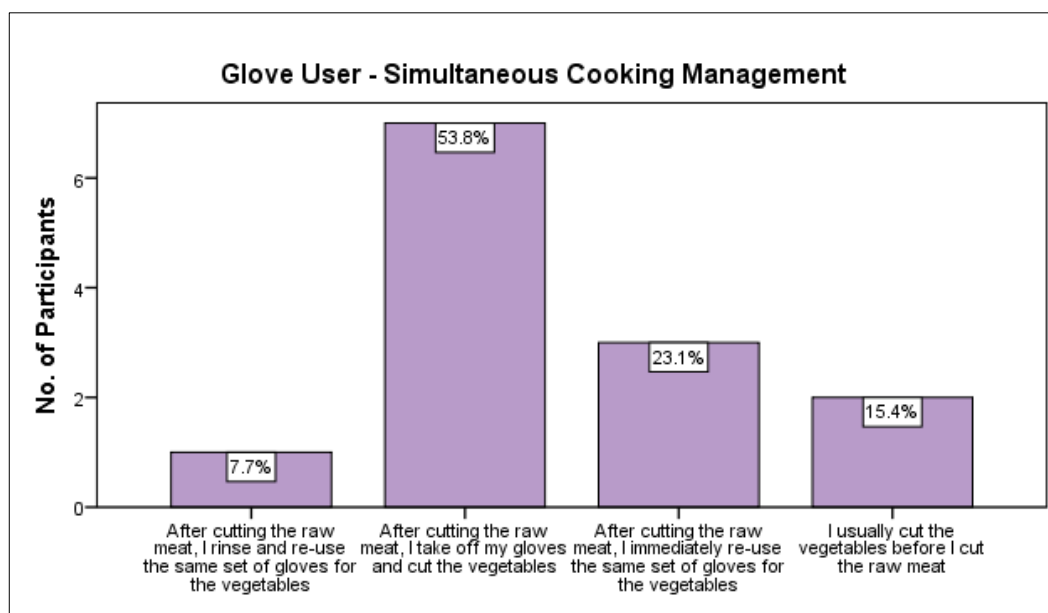


Figure 4-27: Glove user - simultaneous cooking management

The findings indicate that about 85% of the respondents, who wear gloves and do simultaneous cooking, do not appear to take necessary precautions to avoid cross-contamination when preparing fresh meat and vegetables at the same time. The next sub-element to be discussed is glove management.

Glove management is concerned with the frequency at which respondents typically change their gloves when preparing fresh meat. Figure 4-28 reveals the result of glove management.

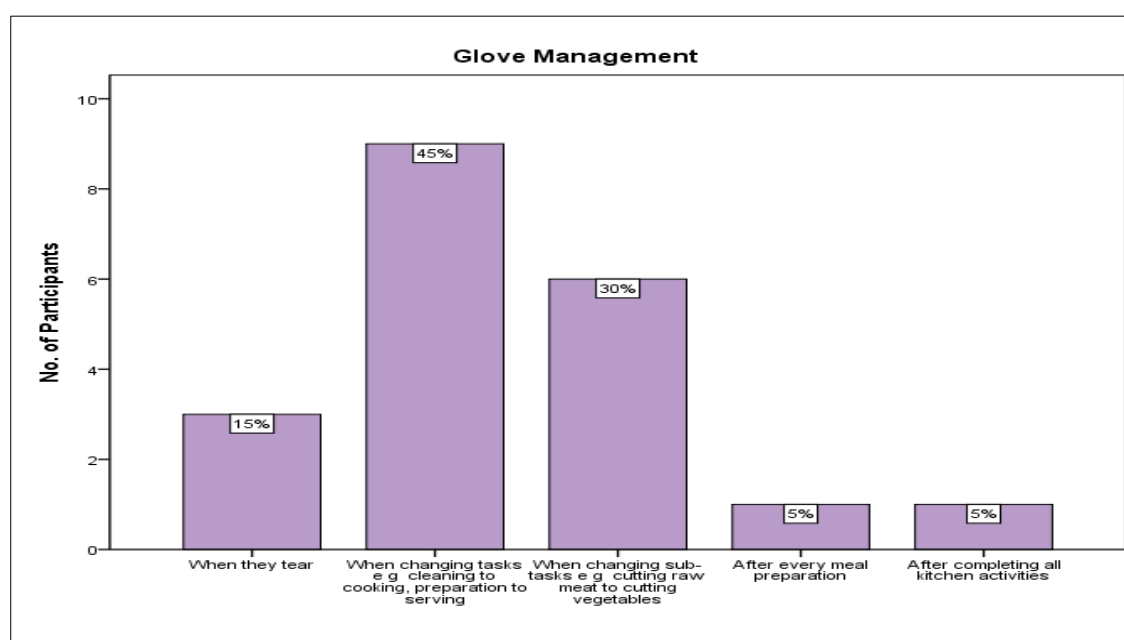


Figure 4-28: Glove management

The findings indicate that about 55% of the respondents, who wear gloves, do not appear to understand how the use of gloves should be managed and how frequent they need to be changed as gloves should be changed when they tear, when changing tasks and sub-tasks (Jackson, 2013). Therefore, for glove users, the findings reveal that a good percentage of them rely upon the use of gloves without necessarily ensuring that it is used in an appropriate manner. The next sub-element to be discussed is non-glove user: simultaneous cooking management.

Non-glove user: simultaneous cooking management determines how the respondents, who do not use gloves, typically manage the simultaneous preparation of fresh meat and vegetables. This question is specifically posed to those who do not wear gloves and do simultaneous cooking. Figure 4-29 reveals the result of non-glove user: simultaneous cooking management.

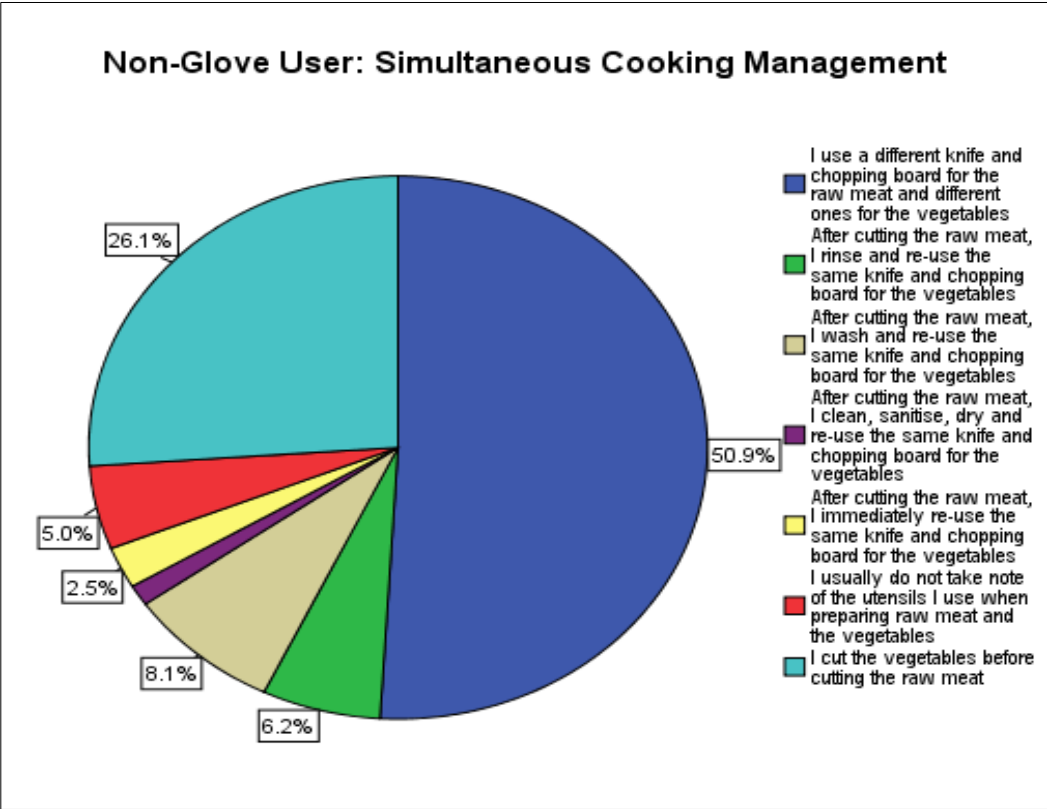


Figure 4-29: Non-glove user: simultaneous cooking management

The findings indicate that about 89% of the respondents, who do not wear gloves and do simultaneous cooking, take necessary precautions, in terms of the cooking utensils, to

avoid cross-contamination when preparing fresh meat and vegetables at the same time. The next sub-element to be discussed is non-glove user: handwashing frequency.

Non-glove user: handwashing frequency determines when respondents, who do not wear gloves, usually wash their hands during fresh meat preparation. Figure 4-30 reveals the result of non-glove user: handwashing frequency.

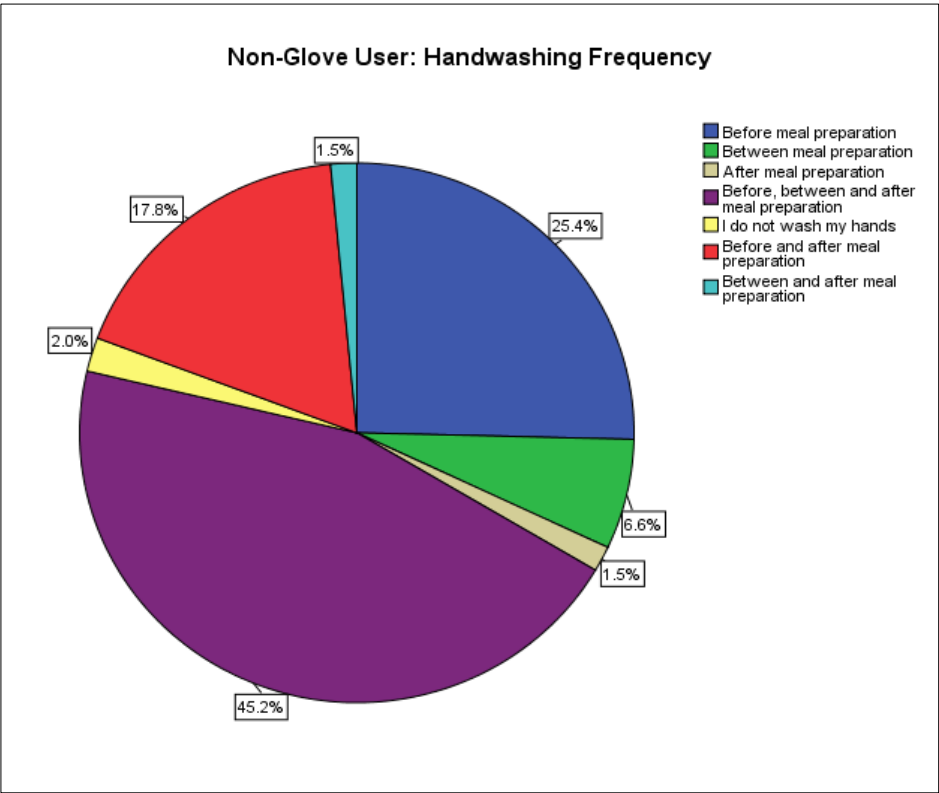


Figure 4-30: Non-glove user: handwashing frequency

The findings indicate that about 55% of the respondents, who do not wear gloves, do not appear to take necessary precautions, in terms of how frequent they wash their hands during fresh meat preparation, so as to avoid bacteria contamination when preparing fresh meat. The next sub-element to be discussed is non-glove user: handwashing process.

Non-glove user: handwashing process determines how respondents, who do not wear gloves, usually wash their hands during fresh meat preparation. This question is specifically posed to those who do not wear gloves during fresh meat preparation and those who have specified that they wash their hands. According to Gilbert et al. (2007), one of the sources of the validated question used to develop the research instrument

(section 3.5.6.2), they stated that “a method that would significantly reduce bacterial contamination i.e. using a combination of soap, hot water, more than 10-second washing and drying” and this was believed to be correct at the time the survey was conducted. However, updated information was retrieved from the relevant government agencies such as FSANZ, NSWFA, MLA and CSIRO which led to the recommendation of using a combination of soap, hot water, more than 30-seconds for handwashing as shown in subsequent chapters (see sections 6.3.4, 6.4.5 and 7.2.3). Figure 4-31 reveals the result of non-glove user: handwashing process.

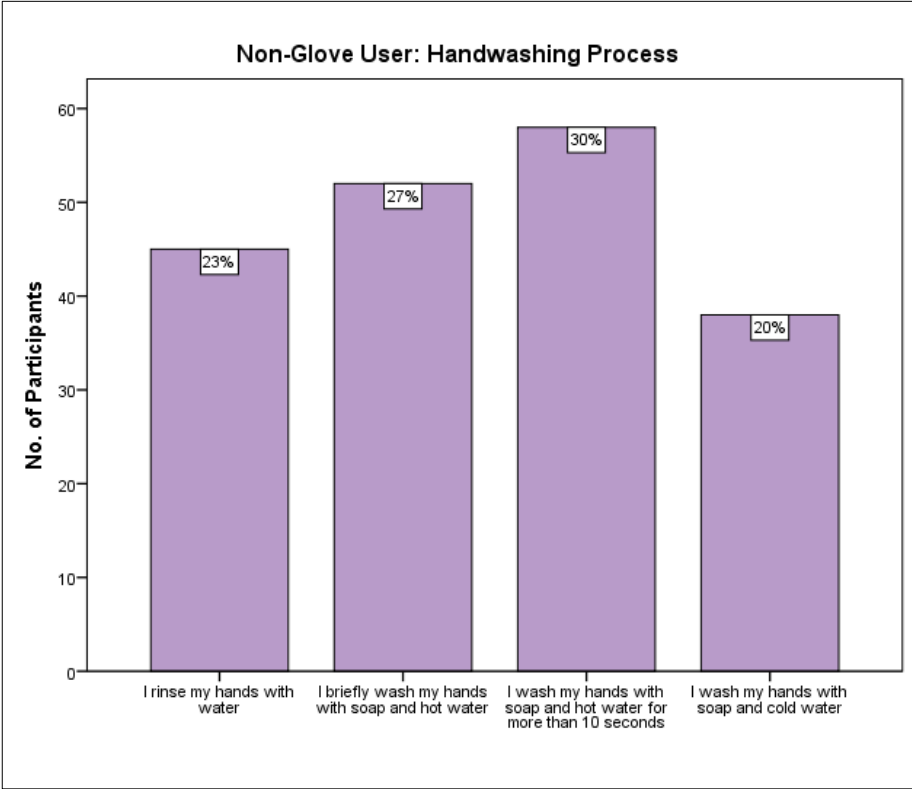


Figure 4-31: Non-glove user: handwashing process

The findings indicate that about 70% of the respondents, who do not wear gloves, do not appear to have the understanding of how they should wash their hands during fresh meat preparation, so as to avoid bacteria contamination when preparing fresh meat. The next sub-element to be discussed is non-glove user: hand drying.

Non-glove user: hand drying determines how respondents, who do not wear gloves, usually dry their hands during fresh meat preparation. This question is specifically posed

to those who do not wear gloves during fresh meat preparation. The Figure 4-32 reveals the result of non-glove user: hand drying.

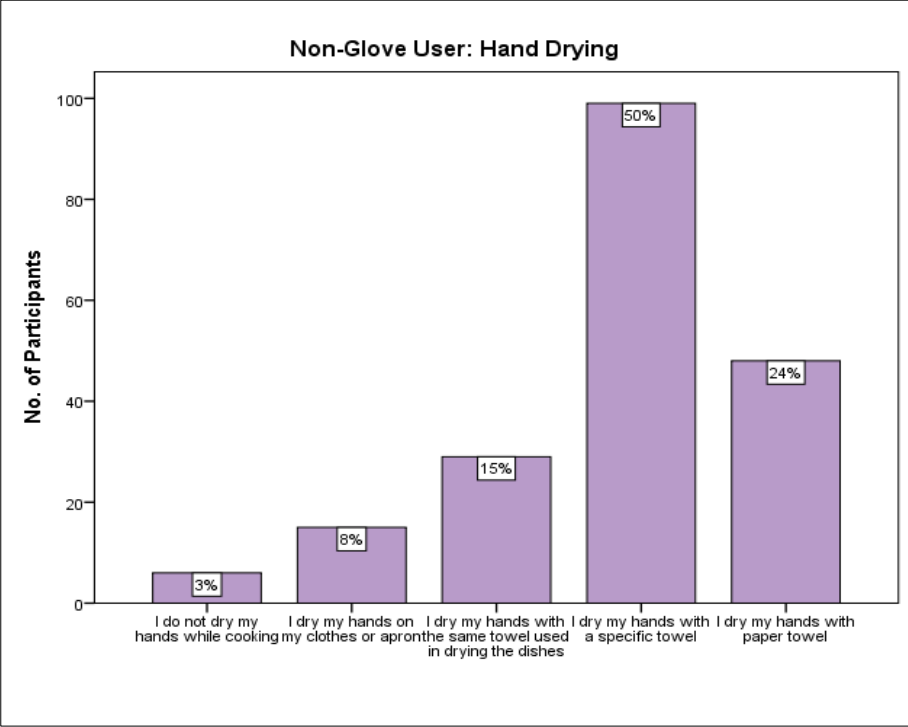


Figure 4-32: Non-glove user: hand drying

The findings indicate that about 74% of the respondents, who do not wear gloves, appear to have the understanding of how they should dry their hands during fresh meat preparation, so as to avoid bacteria contamination. So, for non-glove users, the findings reveal that a good percentage of them have an understanding of kitchen hygiene. However, they still require more knowledge about handwashing practices.

Therefore, the results within this sub-section suggests that, while majority (85%) of the glove users have poor kitchen hygiene practices due to their reliance on gloves, about 70% of the non-glove users lack sufficient knowledge of the recommended handwashing practices. This indicates that this is one of the problematic areas of safe food handling practices which require some attention.

4.3.4 Pre Purchase Data Analysis

This section will discuss the analysis of the two elements that were the focus of the pre-purchase food related questions presented to the research participants using the best-worst scaling technique. The two elements are; attributes and labels considered prior to food purchase. These elements will be discussed in a logical sequence.

4.3.4.1 Pre-Purchase Attribute Preferences

Attributes considered prior to food purchase aim to determine the most important and least important information, which respondents usually consider before the purchase of meat products. Table 4-10 shows the findings of pre-purchase attribute preferences of the respondents.

Table 4-10: Pre-purchase attribute preferences

Attributes	Rank	Bayesian Average
Use-by / Best-before	1	8.3677
Country of origin	2	7.078
Nutritional / health benefits (e.g. low fat, reduced salt, lowers cholesterol, organic)	3	6.6918
Discounted products	4	5.9896
Ingredient List / Allergy Information	5	5.5002
Ethical impact (e.g. animal welfare, fair trade)	6	5.1766
Cooking instructions / Portion Information	7	5.1335
Certification logo/Symbol (e.g. "RSPCA approved")	8	4.6845
Traceability Labels or Information	9	4.4816
Brand	10	3.7364
Environmental impact (e.g. carbon footprint)	11	3.6822

The findings in Table 4-10 indicates that the three most preferred information attributes are the use-by/best-before dates, the country of origin and the nutritional/health benefits respectively.



4.3.4.2 Pre-Purchase Label Preferences

Labels considered prior to food purchase aim to determine the most important and least important information, which respondents usually consider before the purchase of meat products. The three types of labels in this question are the safety or nutritional label, the environmental sustainability label and the ethical or religious label. Table 4-11 shows the findings of pre-purchase label preferences of the respondents while Table 4-12 shows the three most preferred labels.

Table 4-11: Pre-purchase label preferences

Labels	Rank	Bayesian Average
Meat Standards Australia	1	16.1419
National Heart Foundation	2	15.3554
RSPCA Approved Farming	3	13.3285
Livestock Welfare Certified System	4	12.6082
Animal Welfare	5	12.2707
Pesticide Residue Free	6	12.2028
Antibiotic Free	7	11.8947
Australian Certified Organic	8	11.4398
Fairtrade Australia New Zealand	9	10.981
Non Genetically Modified	10	10.9513
Environmental Choice Australia	11	10.3398
Climate Smart Agriculture	12	10.2588
Eco Friendly	13	10.0559
Water Conservation	14	9.9168
Biodegradable Packaging	15	9.9058
Biodiversity Preservation	16	8.4475
HACCP Certified	17	8.3442
National Carbon Offset Standard	18	8.2853
Carbon Footprint	19	7.9769
Kosher Australia	20	5.5307
Halal Australia	21	3.8183

Table 4-12: Three most preferred labels

Most Preferred Labels	Rank
	1
	2

	3
-----------------------------------------------------------------------------------	---

The findings in Table 4-11 indicate that the three most preferred food labels are; Meat Standards Australia, National Heart Foundation and RSPCA approved farming as shown in Table 4-12. It was also revealed that the religious labels were least preferred.

4.3.5 Information Technology Related Data Analysis

This section will discuss the analysis of the four elements that were the focus of the information technology related questions presented to the research participants. The four elements are; information presentation format, perception on app usefulness, app's visual properties and information & communication channels. These elements will be discussed in a logical sequence.

4.3.5.1 Information Presentation Format

Information presentation format aims to determine the respondents' preferences regarding the format in which information on safe food management should be presented to them. This considers visual, textual, verbal or integrated modes of information. Table 4-13 shows the findings of pre-purchase attribute preferences of the respondents.

Table 4-13: Information presentation format

Information Presentation Format	Rank	Bayesian Average
Graphical or Picture-based Information	1	4.0872
Documents or Text-based Information	2	3.7994
Integrated Information Format	3	3.4593
Video-based Information	4	2.6355
Cartoon-like Information	5	2.2301
Audio-based Information	6	1.8208

The findings in Table 4-13 indicates that the two most preferred information presentation formats are picture and text based information formats respectively, while verbal information is least preferred.

4.3.5.2 Perception on App Usefulness

Perception on app usefulness aims to provide insights on the thoughts of the respondents regarding whether a safe food management app will be useful to them or not. The findings of the respondents' perception on the usefulness of an app reveal that 20.8% believe a mobile safe food management application would be useful to them. 46.3% disagree while 32.9% were unsure.

The findings indicate that about 21% of the respondents are confident of the fact that a mobile safe food management app will indeed be useful to them as individuals. This finding might be influenced by the demographic data of the participants as half of the participants were 50 years and above. There is evidence to support the argument that electronic channel preferences through the use of smartphones are more preferred by a younger class of Australians (Worsley et al., 2014). Thus, this substantiates the argument that the finding was influenced by the age of the participants. From those who think a mobile safe food management would be useful to them, further questions were asked to investigate their preferences to provide design insights. It is however important to note here that the participants were not asked to rank the importance of apps as a ranking approach was too limited in terms of the range of comparisons being made by participants.

4.3.5.3 App's Visual Properties

App's visual properties provide insights into the visual requirements of a safe food management app from the respondents. Table 4-14 shows the findings of the app's visual properties.

Table 4-14: App's visual properties

Attribute	Rank	Bayesian Average
Images such as Australian map or State-based maps can be used to illustrate information	1	3.1045
Pie Charts can be used to illustrate information	2	2.8687
Colours, as indicators, should be pleasing and not too bright (e.g., pastels).	3	2.4919
Bar Charts can be used to illustrate information	4	2.3063
Photographs should not be used, and the images should be stylized (e.g., cartoons).	5	1.9656

The findings from Table 4-14 shows that the two most relevant guideline dictating the visual properties of the app on safe food management are the use of images such as Australian map or State-based maps and pie charts in order to illustrate information. Other textual comments on the respondents' requirements of the SFM application are shown in Table 4-15.

Table 4-15: Comments on app design requirements

<i>Bits of info could be in columns</i>
<i>Pictures paint 1000 words, cartoons are probably more amusing to the eye.</i>
<i>Relevant laws and regulations with illustrations and practical examples with hazard and benefits simple to use</i>
<i>I think it should be professional and creative like some options could be presented like a restaurant menu.</i>

4.3.5.4 Information and Communication Channels

Information and communication channel aims to determine the respondents' preferences on the mode of communication they would typically use when learning about the safe management of meat and other food products. Table 4-16 shows the findings of information & communication channels.

Table 4-16: Information communication channels

Attribute	Rank	Bayesian Average
Use a search engine such as Google or read online articles	1	6.9509
Watch television	2	6.5732
Read newspapers, brochures, posters or pamphlets	3	6.3708
Directly access website of a food communication agency or consumer association	4	5.9885
Ask retailers	5	4.8486
Listen to the radio	6	4.4239
Watch videos online e.g. on YouTube	7	4.4017
Use social networking sites such as Facebook, MySpace, Google+	8	3.8418
Read or take part in forums or chat groups online	9	3.6144
Read or write online blogs or use micro-blogs such as Twitter	10	2.9652

The findings from Table 4-16 shows that the three most important communication channels to the respondents are search engines such as Google, television and newspapers/brochures/posters/pamphlets.

4.3.6 Advanced Stage, Phase One – Initial Findings

The focus of the advanced stage of phase one was to generate insights into consumer food safety knowledge gaps. This was done by posing pre-purchase questions, post-purchase questions and questions related to information & communication preferences of the respondents.

The initial findings of the Advanced Stage, Phase One of the research are classified into three key points. First, the post-purchase data analysis has revealed that the three most problematic food handling practices are cooking, kitchen hygiene and storage. **For storage**, the findings reveal that those (72%) who, had problems with safe packaging of fresh meat for storage in the fridge and those (44%) who do not understand the importance of the location where the meat is placed in the fridge, were within the subset of the 26% of all the respondents, who chose chilling as their preferred mode of storage. Consequently, the weight of this finding is quite low. **For kitchen hygiene**, the findings indicate that only 9% of all the respondents use gloves and at least 80% of these (7.2% of all respondents) do not have the recommended safe kitchen hygiene practices. However, 91% of all the respondents do not use gloves and 55% of these (50% of all respondents) do not wash their hands frequently during fresh meat preparation. Also, it was revealed that 70% of those who do not use gloves (64% of all respondents) do not know how to wash their hands appropriately during fresh meat preparation. Consequently, at least 64% of all the respondents do not have safe kitchen hygiene practice and the weight of this finding is slightly above average. **For cooking**, the findings revealed that 48% of all the respondents undercook their meat when pan-frying a 3.5cm fillet steak. In addition, the findings reveal that 94% of all the respondents utilise diverse ways of evaluating the level of doneness of meat, while it is being cooked, which are against the recommended practice. Out of the 6% who use the recommended method of evaluating how well cooked meat is, at least 50% of these (3% of all respondents) cook their meat to temperature that is lower than the best practice. This results in 97% of all the respondents who do not understand the most appropriate method of evaluating the doneness of meat. Consequently, the weight of this finding is the

highest; thus resulting in the most problematic area of food management practices for the respondents.

Second, the pre-purchase data analysis has revealed that the most preferred information attributes is the use-by/best-before dates, thus complementing the existing literature (FSAI, 2003) on the high level of preference Irish consumers portray towards use-by dates.

Third, the information technology related data analysis has revealed that the Meat Standards Australia label, provided by Meat and Livestock Australia (MLA), a marketing and research & development body for Australia's red meat and livestock industry, is the most preferred pre-purchase label. This portrays a high level of trust in the MSA system which primarily focuses on meat quality (Polkinghorne et al., 2008, Watson et al., 2008).

This stage has identified knowledge gap areas on domestic safe food management which require intervention. Based on the insight generated in this stage, it is imperative to explore and learn from existing meat cooking apps as cooking is the most problematic food management practice identified.

4.4 Chapter Summary

This chapter has presented the data analysis that was conducted for Phase One – Identifying Knowledge Gaps and the preliminary findings. These involved two stages: Preliminary Stage, Phase One: Firm Perspective and the Advanced Stage, Phase One: Consumer Perspective. **For the preliminary stage, phase one (Firm Perspective)**, the analysis of the data was done through the use of thematic analysis which was guided by an inductive approach. This resulted in going through several iterations of the open and axial coding levels before being abstracted into the final themes: Authenticity, Branding and Business Agility. Rich description was constructed by extracting facts from the data and presenting them in a coherent manner. In addition, the rich description and the themes were interpreted and discussed to provide important insight into the role the firm plays in updating consumers' food safety knowledge during a recall incident. This led to the identification of the food firm as a potential source of consumer knowledge gaps as the firm was not compelled to close its communication gap with consumers, even when

the food incident occurred. Thus, it becomes more apparent that optimising domestic food safety knowledge post-purchase is largely the responsibility of consumers.

For the advanced stage, phase one (Consumer Perspective), the findings of the collected data, through the consumer online survey, were presented and discussed. There were two different techniques of data analysis and each was presented independently. The first approach to data analysis was the use of survey data to create a set of descriptive statistics that were designed to focus on two core areas; the demography and screening questions as well as post-purchase food handling practices. Furthermore, it provided insights into the areas of food handling practices that are most problematic for the respondents. *The largest knowledge gap areas are safe cooking, kitchen hygiene practices and safe storage respectively.*

The second approach to data analysis was the use of discrete choice experiments through the best-worst scaling technique. Within this approach, the focus was on two core areas; pre-purchase questions on factors influencing respondents' choice of meat purchase and information technology related questions. This approach to analysis has generated insights on the factors influencing the respondents meat purchase in terms of information related attributes and food labels. It was revealed that the three most preferred information attributes are the use-by/best-before dates, the country of origin and the nutritional/health benefits respectively, while the three most preferred food labels are; meat standards Australia, national heart foundation and RSPCA approved farming. Furthermore, it was discovered that the respondents usually make use of search engines to find information when learning about safe management of meat. Graphical/ picture based information or images were the most preferred mode of information and some respondents indeed believe that a mobile safe food management application would be useful to them as individuals.

Therefore, the findings support the argument in section 2.4.3.3 that consumers must learn basic safe food handling practices as smart devices (such as smart fridges, smart microwaves) handle different points in the purchase-to-plate process in silos and do not guarantee that the food on the plate is completely safe to eat. Consequently, the pervasiveness of ICT in the kitchen does not preclude unsafe food handling practices, which means domestic safe food management knowledge becomes a necessity for consumers. Thus, having identified the problem that optimising domestic food safety

knowledge post-purchase is largely the responsibility of consumers, one way to assist them in empowering themselves is by leveraging the pervasiveness and personalised nature of smartphones for knowledge acquisition. As such, a safe food management smartphone app was designed and developed in this study in a way that targets the identified knowledge gap areas. The app was designed in a manner that prioritizes each food safety knowledge gap area according to the extent to which they are identified as knowledge gaps, that is, safe cooking has a higher priority than kitchen hygiene practices, safe storage, reheating and transportation respectively. To achieve this, lessons were learnt from existing safe meat cooking apps and incorporated into the design of the safe food management app. Thus, as the research phases in this thesis are sequential, the preliminary findings from this phase one (Identifying Knowledge Gaps) led to phase two. The next chapter presents the data analysis and preliminary findings of the phase two of this research – Design and Development of the Safe Food Management App.

CHAPTER FIVE

**DATA ANALYSIS AND PRELIMINARY FINDINGS:
DESIGN AND DEVELOPMENT OF THE
SAFE FOOD MANAGEMENT APP**

5 DATA ANALYSIS AND PRELIMINARY FINDINGS: DESIGN AND DEVELOPMENT OF THE SAFE FOOD MANAGEMENT APP

5.1 Introduction

This chapter describes the data analysis and preliminary findings of the design and development of the safe food management smartphone app. As phase one (identifying knowledge gaps) has uncovered the problem that optimising domestic food safety knowledge post-purchase is largely the responsibility of consumers, one way to assist them in empowering themselves is by leveraging the pervasiveness and personalised nature of smartphones. Therefore, a safe food management smartphone app was designed and developed in this study in a way that targets the knowledge gap areas identified from phase one. In phase two, the app was designed in a manner that prioritizes each food safety knowledge gap area according to the extent to which they are identified as knowledge gaps, that is, safe cooking has a higher priority than kitchen hygiene practices, safe storage, thawing, transportation and shopping respectively. To achieve this, lessons were learnt from existing safe meat cooking apps and incorporated into the design of the safe food management app.

Whilst the focus of this phase is the safe food management app, a paper-based tool was also developed to facilitate a baseline. For the development of the paper-based tool, it was the researcher's responsibility to manually gather the evidence-based safe food management information from relevant agencies, structure and present them in a document, therefore no data collection tool was utilised and no data analysis, discussion or interpretation is reported in this thesis. However, a copy of the developed tool is presented in Appendix J. For the development of the smartphone app, the aim of this phase was to learn from existing apps and understand whether there are differences in how safe food management apps should be designed when compared to generic app design principles. The result provided rich insight which was incorporated into the development of a smartphone application for educating and assisting consumers on the safe food management knowledge gap areas identified from the survey in Phase 1. The paper-based tool was developed based on one information modality – text, and the textual information was retrieved from relevant government agencies. The smartphone app was developed based on three information modalities – text, pictures and videos. While the textual information was the same as that of the paper-based tool, the

development of the app was based on lessons learnt from existing food safety apps. The health literacy online heuristics (HLOH) framework was combined with a consumer-based evaluation to holistically assess the usability of the existing applications, their contexts of use and how it relates to the end-users.

The data analysis follows the method detailed in section 3.6. In this chapter, the findings of both usability evaluations are presented and discussed. The data collection techniques for the first usability evaluation included information tasks developed by the researcher based on Monkman and Kushniruk's (2013) HLOH framework (see section 3.3.2). The data collection techniques for the second usability evaluation involved a scenario based focus group session using quantitative and qualitative information tasks, card sorting technique and a questionnaire (see section 3.5.2). The focus group session, through the use of card sorts, was the primary mode of data collection. The data analysis of this stage generated 13 unique axial codes. The chapter is divided into the following sections:

- Section 5.2 describes the actions taken to develop the paper-based tool which was utilised as a baseline.
- Section 5.3 describes the actions taken to design the safe food management smartphone app. It commences by re-introducing the existing apps selected to participate in this research. It progresses to present the part one of the usability evaluation conducted in this research – heuristic evaluation based on the HLOH framework. Next, it presents the part two of the usability evaluation conducted in this research – consumer based evaluation. This was done through a scenario based focus group session. This section includes the findings of the questionnaire, the quantitative and qualitative information tasks and the themes generated from the card sorting technique.
- Section 5.4 integrates the findings generated from both the heuristic evaluation and the consumer-based evaluation.
- Section 5.5 introduces the concept design based on lessons learnt from the existing apps through the HLOH framework (heuristic evaluation) and the consumer-based evaluation.
- Section 5.6 discusses the development of the safe food management app.

- Section 5.7 highlights the preliminary findings from phase two.
- Section 5.8 provides a summary of the chapter.

5.2 Paper-Based Tool as a Baseline

A paper-based tool was developed to provide information about how Australian food consumers can safely manage meat products from the point of purchase till actual consumption. The idea of the tool was based on the findings of the survey which revealed that some Australian consumers lack the knowledge required to safely manage their meat products after purchase. The content of this text-based tool is based on best practice guidelines provided by the following agencies;

- Commonwealth Scientific and Industrial Research Organisation (CSIRO)
- Food Safety Information Council (FSIC)
- Food Standards Australia New Zealand (FSANZ)
- Meat and Livestock Australia (MLA)
- New South Wales Food Authority (NSWFA)

As it was the researcher's responsibility to manually gather the evidence-based safe food management information from relevant agencies, structure and present them in a document, as such no data collection tool was utilised. Therefore, no data analysis, discussion or interpretation is reported in this thesis. However, a copy of the developed tool is presented in Appendix J.

5.3 Designing the Safe Food Management Smartphone App

While the textual information was the same as that of the paper-based tool, the design and development of the app was based on lessons learnt from existing food safety apps. This led to the adoption of the health literacy online heuristics framework while combining it with a consumer-based evaluation to holistically assess the usability of these applications, their contexts of use and attributes of the end-users. The sub-sections within section 5.3 detail the process of selecting the existing apps, the heuristic evaluation conducted on the apps, the consumer based evaluation conducted on the apps, which led to the results of the card sorting technique and the themes generated from the process. Following section 5.3, subsequent sections detail the integration of the heuristic

and the consumer-based evaluations which led to design considerations; the concept design; and the actual development of the safe food management app.

5.3.1 Existing App Selection

As earlier stated in the methodology (section 3.3.2), the current focus for the next phase of this research involves the selection of three existing apps (text-based app, audio-visual app and integrated app) that most clearly addresses the safe food handling practice being targeted, in this case – safe meat cooking. An app is defined as “text based” if it mainly communicates with its users based on textual information modality. An app is defined as “text and picture based” if it mainly communicates with its users based on textual and visual information modalities. An app is defined as “integrated” if it mainly communicates with its users based on textual, visual, and sound/audio information modalities.

Existing applications were selected to facilitate:

- Easy and low cost investigation of three different information modalities which will support users (non-technical; food consumers) to become rapidly familiar with these modalities thereby enabling them to contribute to subsequent preferences for design by having provided them with some concrete examples to work from in the first instance (Houde and Hill, 1997).
- A more effective collection of true human performance data as there is evidence to suggest that a high-fidelity prototype/fully functional prototype provides a more valid evaluation than a paper or low fidelity prototype (Lim et al., 2006).
- There is also a precedent for this type of approach in developing mobile solutions using existing applications (Fleury et al., 2010).

Based on the aforementioned reasons, existing safe meat cooking apps were selected. The three apps were selected based on the following criteria: it must be focused on end-consumers not professional food handlers; it must contain the appropriate meat cooking temperature and/or cooking time; it must be given a minimum of 4 out of 5 star rating. Due to ethical restrictions, only the pseudo-names can be specified. Therefore, the text based app is herein referred to as TbA; the picture and text based app is herein referred to as PTA while the integrated app is herein referred to as InA.

5.3.2 Heuristic Evaluation

Following the selection of the three apps (text-based app, audio-visual app and integrated app), heuristic evaluation based on Monkman and Kushniruk's (2013) framework was conducted in order to identify problems with, arguably the three best existing apps on safe meat cooking, from an expert's perspective. The framework was selected due to its relevance for the context defined in this study. It is based on the following usability factors; screen, content, display, navigation and interactivity. The heuristics were developed (through the modification of design guidelines) for evaluating health app usability. Based on the frequency, impact and persistence of usability problems, a three-level severity scale was utilised with numbers 1, 2 and 3 representing mild, moderate and severe respectively. Table 5-1 shows the summary of heuristic evaluation of the three selected apps. The full version of the analysis is included in Appendix K.

Table 5-1: Summary of heuristics evaluation of the three apps

Usability Factors	Heuristics	Evaluation Results (Text based app = TbA, Picture & Text app = PTA while Integrated app = InA)
Screens	Home screen	PTA was simple and engaging while TbA and InA had problems with a severity score of 2 and 3 respectively.
Content	Hierarchy, promotion, positive tone, specific, colloquial, accurate, spacious – display content clearly on the page, personal and headings	All three were satisfactory with respect to hierarchy, specific, colloquial, accurate and the use of meaningful headings. However, TbA and PTA failed to specify the benefits of taking action. TbA had a severity rating of 3 each while PTA scored 2 on “personal” heuristics respectively.
Display	Consistency, font, spacious – use white space and avoid clutter, location of content, images, contrast and accessibility	While all three apps were relatively satisfactory in terms of consistency, spacious, location of content and contrast. TbA had issues with font, with a severity score of 2; TbA could not be assessed for “images” as it is text based; and all three apps were not accessible to people with disabilities – scoring 3 on accessibility.
Navigation	Topics, orientation, back button, linear navigation, buttons, links and search	Whilst all three apps were relatively satisfactory on topics, back button, linear navigation and buttons; PTA did not enable easy access to home and menu screens thus scoring 2 on “orientation”. TbA did not use

			links effectively neither did it include simple search options– scoring 3 each on “links” and “search”. InA also failed to include simple search and browse options, thus scoring 3.
Interactivity	Engage, multimedia and new media	print, and	All three apps did not provide tools to share content and feedback about experiences; thus scoring 3 on “engage”. All three apps were not printer friendly; scoring 3 on “print”. All three apps did not provide tools to explore new media such as Twitter or text messaging – scoring 3 on “new media”.

The findings of the heuristics evaluation reveals that none of the apps currently comply with the best practice described by the framework as they were most deficient under “interactivity” as a usability factor. Therefore, the apps could proceed to the next stage of the consumer focused usability evaluation. This approach draws on Kushniruk et al. (1997), Kushniruk (2002); as usability testing is inserted into the design cycle, based on the evidence that it leads to 10-fold reduction in usability problems after implementation.

5.3.3 Consumer Based Evaluation - Focus Group Session

Using the apps as a high fidelity prototype in a scenario-based focus group session, consumer focused usability evaluation was conducted. This aimed to identify the impact of the three information modalities on consumer understanding and to generate user requirements for a safe meat cooking app. This section includes the findings of the questionnaire, quantitative and qualitative information tasks and the card sorting technique. The findings of the questionnaire on the demography of the participants are in Appendix AB.

5.3.3.1 Quantitative Information Tasks

This section presents the findings from the quantitative information tasks presented to the participants. As discussed in section 5.2 the three selected apps are pseudo named TbA, PTA and InA meaning text-based app, picture & text app and integrated app respectively due to ethical restrictions. As the respondents worked in pairs, there were 5 groups: Groups A, Group B, Group C, Group D but Group E had only 1 participant. One member of each pair worked on the app while the other wrote the answers in the answer sheet. The arrangement of the apps and scenarios were randomised for each group such

that Groups A, B and C had the questions in different orders. However, Group D had the same order of questions as Group A and Group E had the same order of question as Group B. First, as discussed in the methodology (section 3.5.2); the following scenario was presented to the participants for the TbA app (*see Appendix L for question sheet*).

You are inviting a few friends for dinner, and your recipe includes beef steaks. You want to cook a rare 4cm (centimetres) thick rump steak to perfection. The steak weighs 500g (about 1 pound). Use the following app to find some information about how to cook it. Please note that either °C or °F is acceptable.

Download the “TbA” app and browse through it in order to find the appropriate information you need so as to cook a perfect steak.

After downloading the app, please record the time you start and the time you stop using the app to find the required information – **Start time & End time**. *Please be careful to ensure you only record the time you use in browsing the app **NOT** the time you use in writing your answers.*

Figure 5-1: Scenario 1 for TbA app

Based on the scenario in Figure 5-6 the participants were asked to record their responses in the answer sheet provided (*see Appendix M*). The finding for scenario 1 is shown in Table 5-3.

Table 5-2: Quantitative information task – TbA app

S / N	Question	Group A	Group B	Group C	Group D	Group E	Actual Answer
1	Start time	6:47pm	7:01pm	6:58pm	6:49pm	7:03pm	-
2	Did you already have the aforementioned app on your phone? (Yes or No)	No	No	No	No	No	-
3	Cooking time (how long to cook?)	N/A	Not available	35 mins	20 – 30 mins	Cannot find how long	30-35mins
4	Cooking method <i>e.g. Pan Fry, Barbecue, Roast etc.</i>	Grilling	Grilling	Roast	Barbecue	For any method	Grilling / Roast
5	Temperature (°F or °C)	125 – 130 F	130 F	125 – 130 F	125 – 130 F	125 – 130 F	125 – 130 F
6	Would you use the app again? Why?	No – Confusing & non-intuitive	No – Didn’t give cooking times	No – Too cluttered, answers weren’t easy to find	No	No - Not enough information to be useful	-
7	End time	6:57pm	7:05pm	7:04pm	6:58pm	7:07pm	-
	Time Difference	10 mins	4 mins	6 mins	9 mins	4 mins	

Based on Table 5-3, the information task for TbA app took the respondents between 4 and 10 minutes with an average completion time of 6 minutes 36 seconds. Whilst all the participants found the temperature and most found the cooking method on the app, it was interesting to note that only 2 groups (C and D) were able to locate the cooking time on the app. All the participants stated that they would never use the app again for reasons such as lack of information, confusing and non-intuitive, too cluttered and difficulty in finding the answers.

Second, as discussed in section 3.5.2, the following scenario was presented to the participants for the PTA app (*see Appendix L for the full question sheet*).

You are inviting a few friends for lunch, and your recipe includes lamb steaks. You want to cook a medium 2.5cm (centimetres) thick lamb fillet or tenderloin to perfection. Use the following app to find some information about how to cook it.

Download the “PTA” app and browse through it in order to find the appropriate information you need so as to cook a perfect steak.

After downloading the app, please record the time you start and the time you stop using the app to find the required information – **Start time & End time**. *Please be careful to ensure you only record the time you use in browsing the app **NOT** the time you use in writing your answers.*

Figure 5-2: Scenario 2 for PTA app

Based on the scenario in Figure 5-7 above the participants were asked to record their responses in the answer sheet provided (*see Appendix M*). The finding for scenario 2 is shown in Table 5-4.

Table 5-3: Quantitative information task – PTA app

S / N	Question	Group A	Group B	Group C	Group D	Group E	Actual Answer
1	Start time	7:00pm	6:52pm	7:04pm	7:01pm	6:49pm	-
2	Did you already have the aforementioned app on your phone? (Yes or No)	No	No	No	No	No	-
3	Cooking time (how long to cook?)	“to appropriate doneness”	5 mins	No information	No idea, not there	Just over 1 min on a BBQ/grill	15mins
4	Cooking method <i>e.g. Pan Fry, Barbecue, Roast etc.</i>	Barbecue	BBQ	Hot surface, pan fry, BBQ, stir fry	BBQ	BBQ	Pan Fry, Barbecue, Stir Fry
5	Temperature (⁰ F or ⁰ C)	“Hot surface”	Not given	Hot, reduce to medium	No idea – not there	Can’t find it	Not required for pan-fry, stir-fry, barbecue. If other methods are used it is required but it is not available in the app
6	Would you use the app again? Why?	No – Not enough information	No – Too difficult	Yes – Recipes are interesting add-on. Breakdown of animal	No	No – App seems to not work on my phone (iPhone 4s). Actually the search is just not intuitive	-
7	End time	7:06pm	6:59pm	7:10pm	7:05pm	7:00pm	-
	Time Difference	6 mins	7 mins	6 mins	4 mins	11 mins	

Based on Table 5-4, the information task for PTA app took the respondents between 4 and 11 minutes with an average completion time of 6 minutes 48 seconds. All the participants were able to locate the recommended cooking method on the app. All the

participants were expected not to locate the temperature because the app only focused on cooking methods that did not necessarily require temperature such as pan-fry, stir-fry and barbecue. However, the question was intentionally asked to facilitate consistency across the three scenarios and apps. It was however interesting to note that none of the groups were able to locate the cooking time on the app. Moreover, most of the participants stated that they would never use the app again for reasons such as lack of information, non-intuitive search, compatibility issues and difficulty in using the app. One of the groups however stated that they would use the app again because they liked the breakdown of the animal and that the recipes were an interesting add-on.

Third, as discussed in section 3.5.2, the following scenario was presented to the participants for the InA app (*see Appendix L for the full question sheet*).

You are inviting a few friends for barbecue (BBQ), and your recipe includes beef steaks. You want to cook a medium rare 3cm (centimetres) thick sirloin steak to perfection. Use the following app to find some information about how to cook it.

Download the “InA” app and browse through it in order to find the appropriate information you need so as to cook a perfect steak.

After downloading the app, please record the time you start and the time you stop using the app to find the required information – **Start time & End time**. *Please be careful to ensure you only record the time you use in browsing the app **NOT** the time you use in writing your answers.*

Figure 5-3: Scenario 3 for InA app

Based on the scenario in Figure 5-8 the participants were asked to record their responses in the answer sheet provided (*see Appendix M*). The finding for scenario 3 is shown in Table 5-5.

Table 5-4: Quantitative Information Task – InA app

S / N	Question	Group A	Group B	Group C	Group D	Group E	Actual Answer
1	Start time	7:08pm	7:05pm	6:49pm	7:07pm	7:10pm	-
2	Did you already have the aforementioned app on your phone? (Yes or No)	No	No	No	No	No	-
3	Cooking time (how long to cook?)	12 mins 45 secs	12 mins 45 secs	12 mins 45 secs	12 mins 45 secs	12 mins 45 secs	12 mins 45 secs
4	Cooking method e.g. Pan Fry, Barbecue, Roast etc.	BBQ	BBQ	BBQ	BBQ	BBQ	BBQ
5	Temperature (⁰ F or ⁰ C)	N/A	Medium	Hot reduce to medium	60 – 65 C	No temperature given. Hot to medium	60-65 C
6	Would you use the app again? Why?	Yes – Informative. Provides useful guidance	Yes – Good preparation information. Timer	Yes – Easy to operate, really clear interface	Yes	Yes – Intuitive and informative	-
7	End time	7:11pm	7:08pm	6:51pm	7:09pm	7:14pm	-
	Time Difference	3 mins	3 mins	2 mins	2 mins	4 mins	

Based on Table 5-5, the information task for PTA app took the respondents between 2 and 4 minutes with an average completion time of 2 minutes 48 seconds. All the participants were able to locate the recommended cooking time on the app. It was however interesting to note that only one of the groups was able to locate the recommended cooking temperature on the app. All the participants stated that they would use the app again because it is informative, provides useful guidance, easy to operate, intuitive and it has a clear interface.

5.3.3.2 Qualitative Information Tasks

This section presents the findings from the qualitative information tasks presented to the participants. Following on from the quantitative and the card sorting sections, the participants were asked to answer a question on each of the apps in as much detail as they could.

First, as discussed in section 3.5.2, the same scenario was presented to the participants for the TbA app (*see Appendix N for the full question sheet*). This was done to remind them of the scenario. Thereafter, the participants were asked the question as shown in the excerpt below.

Scenario 1 - (Reminder)

You are inviting a few friends for dinner, and your recipe includes beef steaks. You want to cook a rare 4cm (centimetres) thick rump steak to perfection. The steak weighs 500g (about 1 pound). Please note that either °C or °F is acceptable.

1. Assuming you will use a thermometer while cooking; describe how you would ensure the rare 4cm thick rump steak is safely cooked without losing its taste?

Figure 5-4: Scenario 1 - Reminder for TbA app

Based on the scenario in Figure 5-9 the participants were asked to record their responses in the answer sheet provided (*see Appendix O*). The finding for scenario 1 is shown in Table 5-6.

Table 5-5: Qualitative information task – TbA app

Question	Assuming you will use a thermometer while cooking; describe how you would ensure the rare 4cm thick rump steak is safely cooked without losing its taste?
Group A	Will cook at over 145 F
Group B	135 F temp. No times given. Grilling.
Group C	App probably suggested core temperature as guide as distinct from cooking temperature but this information wasn't clear. It only made sense in hindsight after reading this question. We only wondered why the temperature was quite low with a relatively short cooking time. Even worse to use as you don't get a guide on cooking temperature at all.
Group D	We couldn't find the time, so there is no way of ensuring no loss of flavour
Group E	30 mins, hot pan but test temperature to ensure consistent cooking. I don't know correct pan/steak temperature. Then 10 minutes. 5 mins for both sides. Over 180C preheat 25mins perhaps 30 mins
Actual Answer	Will cook to 125 – 130 F. 30 – 35 mins cooking time. Grilling or Roasting. No other tip is given in the app.

Although the app provided the recommended cooking temperature and time, none of the participants could remember the information retrieved from the text based app (TbA). Those (Groups A and B) who made attempts to remember got the information entirely

wrong. However, for Group E, there is evidence that suggests the participant relied on prior knowledge to answer the question as the response provided to the quantitative section revealed that the group could not locate the recommended cooking time.

Second, as discussed in section 3.5.2, the same scenario was presented to the participants for the PTA app (*see Appendix N for the full question sheet*). This was done to remind them of the scenario. Thereafter, the participants were asked the question as shown in the excerpt below (Figure 5-10).

Scenario 2 - (Reminder)

You are inviting a few friends for lunch, and your recipe includes lamb steaks. You want to cook a medium 2.5cm (centimetres) thick lamb fillet or tenderloin to perfection.

2. Describe how you would cook a perfect medium 2.5cm thick lamb fillet/tenderloin?

Figure 5-5: Scenario 2 - Reminder for PTA app

Based on the scenario in Figure 5-10, the participants were asked to record their responses in the answer sheet provided (*see Appendix O*). The finding for scenario 2 is shown in Table 5-7.

Table 5-6: Qualitative information task – PTA app

Question	Describe how you would cook a perfect medium 2.5cm thick lamb fillet/tenderloin?
Group A	Put it on a hot surface till required doneness.
Group B	5 minutes BBQ. Garlic Marinade. 10 minutes preparation if you choose to follow the recipe.
Group C	BBQ on hot plate. No time given. Only cook to desired taste.
Group D	Found the cut and method but “cook until desired doneness” was insufficient. We wanted rough times.
Group E	Oven 180 C, 25 mins on pan on hot. Similar time; may be less. Thawed 10-15 mins before cooking.
Actual Answer	<p><i>Preparation time is 10 minutes. Cooking time is 15 minutes. Recommended cooking methods are Pan Fry, Barbecue and Stir Fry. Cook on a hot surface till appropriate doneness.</i></p> <p><i>If the recipe is followed, then;</i></p> <p><i>Brush the lamb tenderloins with combined sesame oil and hoisin. Season with salt and pepper. Preheat a non-stick pan to moderately hot. Keep the heat at moderately high. Cook one side until the first sign of moisture appears on the uncooked side, turn and cook other side. Cook till all sides are browned.</i></p>

From Table 5-7, the findings indicate that all the groups remembered one or more tips from the app; thus showing that the participants indeed understood the information they had earlier retrieved from the app. This finding is however interesting because almost all the groups clearly stated that they would never use the app again (except group C).

Third, as discussed in section 3.5.2, the same scenario was presented to the participants for the InA app (*see Appendix N for the full question sheet*). This was done to remind them of the scenario. Thereafter, the participants were asked the question as shown in the excerpt below (Figure 5-11).

Scenario 3 - (Reminder)

You are inviting a few friends for barbecue (BBQ), and your recipe includes beef steaks. You want to cook a medium rare 3cm (centimetres) thick sirloin steak to perfection.

3. Remember the method of cooking here is BBQ; describe the actions you would take before and during the cooking process of the medium rare 3cm thick sirloin steak to ensure best results.

Figure 5-6: Scenario 3 - Reminder for InA app

Based on the scenario in Figure 5-11, the participants were asked to record their responses in the answer sheet provided (*see Appendix O*). The finding for scenario 3 is shown in Table 5-8.

Table 5-7: Qualitative information task – InA app

Question	Remember the method of cooking here is BBQ; describe the actions you would take <u>before</u> and <u>during</u> the cooking process of the medium rare 3cm thick sirloin steak to ensure best results.
Group A	Weigh it. Measure thickness. Research cooking temperature. Use thermometer.
Group B	12 minutes 45 seconds. Medium temperature. Barbecue. Leave out of fridge for 10 minutes. Bring to room temperature.
Group C	Before: Take out of fridge 10 minutes before cooking. Preheat BBQ to hot. During: Reduce heat to medium. 12 minutes to cook.
Group D	Before: we selected cut, method of cooking, thickness and level of doneness. During: 60-65 C, BBQ, 12 minutes 45 seconds.
Group E	Hot grill with consistent temperature. Grill on two sides 5 minutes each.
Actual Answer	<i>Before cooking, remove the beef from the fridge 10 minutes prior to cooking. Oil the beef. Ensure the surface is hot. Once the beef hits the surface, reduce temperature to medium. Cooking time 12 minutes 45 seconds, cooking temperature 60 – 65 C and cooking method is BBQ.</i>

From Table 5-8, the findings indicate that many of the groups remembered one or more tips from the app; thus showing that the participants indeed understood the information

they had earlier retrieved from the app. However, it was surprising to note that three of the groups remembered the recommended cooking time provided in the app. Group E did not remember the exact information retrieved from the app. Group A did not understand the question, therefore it is unclear whether they actually remembered the information they had earlier retrieved or not. Despite the fact that they did not answer the question as expected, their responses show that they could recall the steps carried out while using the app.

In summary, whilst the participants clearly preferred the InA app, the results show that they could recall more information from the PTA app. Perhaps, this may be due to the larger amount of time spent using the PTA app when compared to the InA app.

5.3.4 Card Sorting Technique for the Consumer-Based Evaluation

This section presents the results from the focus group session. On completion of the quantitative session, the participants were given two blank cards each and were asked to write out the problems with the TbA app they had used. The cards were collected and sorted on the board by the participants together with the facilitator to establish group consensus. Once this was completed and themed, another set of two blank cards of the same colour was given to the participants and they were asked to write the benefits of the TbA app. The cards were collected, sorted and themed as done previously. The same procedure was followed for the PTA and InA apps respectively. The discussion of each of the apps in terms of the issues, benefits and associated excerpts from the participants is in Appendix V. However, a summary of the findings is presented and discussed here.

5.3.4.1 Issues with Existing Apps

This section discusses the problems with the existing meat cooking apps as identified by the participants of the study. The findings of the study indicate that there are ten different issues with the three apps considered, which must be avoided in the SFM app being designed and developed. These are listed as follows and subsequently discussed: Accessibility; Context of picture use; Context of sound use; Design and Aesthetics; Ethical Perception; Familiarity; Information content / Functionality; Layout of information; Locating information; Platform compatibility; and Value add.

A. Accessibility

This involves the level of ease with which users can locate the app, download it, and start using it without unnecessary hiccups. The integrated app (InA) had poor

accessibility because it took a long time to download. The finding here was quite unusual because, of all three apps, the InA app had the smallest size with about 15 megabytes. Therefore, a lengthy download time is uncalled for. However, as this was highlighted by only one participant, the underlying cause may well be the smartphone of the participant.

B. Context of Picture Use

This is concerned with the applicability of an image or picture in relation to the context for which it was provided. The picture and text based app (PTA) used an image to present information in a counter-intuitive context; thus generating a negative reaction from the users. The finding here is unusual as it is widely believed that pictures are great in communicating information. The findings of the survey in section 4.3.5.3 revealed that a participant stated that “pictures paint 1000 words”. Whilst this may be true, the context with which that information is delivered and the purpose for which the picture is designed to achieve is important, as evidenced by the findings in this study. This feature is not suitable for consumers attempting to utilise the app during the process of food preparation as described by the aforementioned scenarios.

C. Context of Sound Use

This refers to the applicability of a sound or an audible prompt in relation to the context for which it was provided. The integrated app (InA) utilised sound prompts for the ‘favourites’ and ‘queue’ features which was considered ‘annoying’ and ‘unnecessary’ by the users. The finding here is in consonance with the findings from the survey (see section 4.3.5.3) as respondents indeed ranked sound/audio based information modality as the least preferred. However, as revealed by participants in Appendix V, the timer function, which is sound-based, was considered a desirable feature because it provided a reasonable and useful cue to action. Therefore, the findings indicate that the problem is not the use of sound-based information modality to communicate information, but the context in which it is used.

D. Design and Aesthetics

This is concerned with the appearance or the overall “look and feel” of the app. The text-based app (TbA) was not appealing to the users as it had a poor design. The design was considered poor because the pages appeared cluttered, ugly and were unintuitive. This underscores the importance of the visual features of an app. Despite the fact that the

survey revealed that text based information was highly ranked by the respondents when safe food information is being delivered, this finding indicates that text-based information only does not suffice. It must be accompanied by an appealing design, as revealed by the findings in the scenario-based focus group session.

E. Ethical Perception

This is concerned with the moral perception of users in relation to animal welfare. Whilst this code emanated as a benefit of the picture and text based app (PTA) (see Appendix V), it was not necessarily a positive feature as the users portrayed mixed feelings about the appropriateness of showing an animal that has been dissected or dismembered. Despite the fact that the users in the study are red meat eaters, the image of the animal was not necessarily permissible. Therefore, this finding indicates that a safe food management (SFM) app should not incorporate any picture or feature that has the tendency to emanate polarizing views from its users.

F. Familiarity

This refers to the first impression experience users have once the app is launched. It involves the level of ease with which users relax into and get acquainted with the app. The integrated app (InA) emanated an overwhelming influence on the users on its first use due to the lack of an introductory/landing page. Once the app is launched it does take a while to understand what is required of a user thus leading to a confronting experience. Therefore, a SFM app should have a landing page that introduces the users to features of the app.

G. Information Content / Functionality

This involves the completeness of the information being delivered by the app. It is concerned with ensuring the app is indeed useful and that it achieves the purpose for which the user downloaded it in the first place. Whilst the TbA and InA apps provided all the information required by the participants, the findings indicate that the participants were unhappy with all three apps as they could not locate the information required. On the other hand, it was only the PTA app that failed to provide the recommended cooking temperature which was required by the users to cook safely. Therefore, user's expectation of the PTA app was not met though the app aimed to educate users about different meat types and the suggested cooking methods and recipes.

H. Layout of Information

This refers to the information architecture of the app, in terms of how information is layered within the app environment. It determines the experience users have when searching for information. Both the TbA and PTA apps have poorly layered information which is a result of the information architecture. This is the source of the difficulty users experienced while trying to search for information. Therefore, the findings suggest that a lot of attention has to be paid to the structure of information within the app.

I. Locating Information

This involves ease with which users can navigate through the app but more importantly, to retrieve the required information. It was most difficult for the users to locate information within the PTA app when compared to the other two apps. This is evidenced by the need for participants to use the search button to locate information which was also unsuccessful. This is a direct implication of the poor information layout which should be guided against when designing a SFM app.

J. Platform Compatibility

This is concerned with the ability of the app to work in multiple mobile operating system environments. The importance of this code stems from the fact that there are various types of smartphones and users should not have to worry about the compatibility of the app with their phone. The TbA app experienced some compatibility issues as some users could not download it on their smartphone. Therefore, when developing a SFM app, it is important to ensure the app is compatible with multiple platforms so as to encourage a better potential for user uptake.

K. Value Add

This involves the extra pieces of useful information being delivered which is beyond the core requirements of the app. It is concerned with ensuring the app does not only achieve the purpose for which the user downloaded it in the first place but provides more value for the user. The InA app was focused on beef only but the users expected a variety of meat types thus making the app less appealing to the users. Whilst it was noted by one of the users that the app only claimed to deliver beef related information, others believed added value is a good feature it could have incorporated.

In summary, the findings have revealed the issues with all the existing apps that should be avoided when developing the new SFM app, as shown in Table 5-9. In the table, the app(s) emanating the identified issue is highlighted by using the cross (×) sign.

Table 5-8: Lessons learnt from existing app issues

Issues	Apps Emanating the Issues			Lessons Learned
	Text-based App (TbA)	Picture and Text-based App (PTA)	Integrated App (InA)	
Accessibility			×	Ensure fast app download
Context of picture use		×		Ensure appropriate context when using picture to deliver information
Context of sound use			×	If sound must be used, ensure it is only used sparingly and in an appropriate context
Design and Aesthetics	×			Ensure app is visually appealing and not cluttered regardless of the information modality in focus
Ethical Perception		×		Ensure the app does not utilise images which can emanate polarizing views.
Familiarity			×	Ensure there is an introductory / landing page
Information content / Functionality		×		Ensure app delivers all the required information for which the user downloaded the app.
Layout of information	×	×		Ensure the information architecture is well thought out
Locating information		×		Ensure users can easily navigate the app and find information
Platform compatibility	×			Ensure app is compatible with diverse platforms to cater for a broad population of users.
Value add			×	Ensure app provides some extra value, however little.

5.3.4.2 Benefits of Existing Apps

This section discusses the benefits or positive features of the existing meat cooking apps as identified by the participants of the study. The findings of the study indicate that there are eight different positive features identified from the three apps considered, which should be incorporated in the SFM app being designed and developed. These are listed as follows and subsequently discussed: Accessibility; Context of picture use; Design and Aesthetics; Information content / Functionality; Information Tone; Locating information; No Cost to Users; and Value add.

A. Accessibility

This involves the level of ease with which users can find the app, download it, and start using it without unnecessary hiccups. The text based app (TbA) and the picture and text based app (PTA) were easily accessible to the users as they could quickly download the apps. As users noted the importance of this feature, it is imperative to ensure the SFM app is easily accessible to the users.

B. Context of Picture Use

This is concerned with the applicability of an image or picture in relation to the context for which it was provided. As the picture and text-based app (PTA) used the image of an animal to deliver information about the different meat cuts, this feature was perceived as educative. For the purpose of making consumers aware about the different cuts of meat, the app is very useful.

Whilst this feature of the app is desirable, perhaps, it would have been better utilised if it solely focused on informing the users about the animal breakdown without necessarily associating it with the delivery of other information. Associating the animal image with the delivery of other information means that the nothing else can be achieved in the app without knowing or finding the actual cut required by the user. Therefore, this finding has revealed that images work well in apps, when achieving a single purpose.

C. Design and Aesthetics

This refers to the appearance or the overall “look and feel” of the app. The picture and text based app (PTA) and the integrated app (InA) were visually appealing to the participants. This is based on the fact that the interface of both apps is intuitive, the layout looks appropriate to the users, the pictures were pleasing and the pages looked beautiful; thus making the apps desirable to the users. More specifically, the choice of colours of the InA was also appealing. Therefore, this finding has revealed that the SFM app should be attractive to its users.

D. Information Content / Functionality

This involves the completeness of the information being delivered by the app. It is concerned with ensuring the app is indeed useful and that it achieves the purpose for which the user downloaded it in the first place. The text based app (TbA) and the integrated (InA) app both provided all the information required for the participants to

address the questions relating to the aforementioned scenarios in this chapter. However, from the perspective of the participants, this was not the case, as many of them found it difficult to find the information. Therefore, it is imperative to ensure the app that will be designed contains the required information but more importantly, to ensure the information can be easily located.

E. Information Tone

This refers to the level of encouragement provided by the style or tone of the information being presented to the users of the app. The instructions provided by the integrated app (InA) had a positive influence on the users as it was deemed reassuring. Therefore, the findings reveal that it is imperative for the communication tone of the app to be friendly whilst supporting the users in each step.

F. Locating Information

This is concerned with the ease with which users can navigate through the app and to retrieve the required information. Both the text based app (TbA) and the integrated app (InA) are simple to use in that users could easily navigate the apps to locate the information required. Thus, incorporating intuitiveness into the InA app is one of the important features that make the app desirable to the participants. Therefore, the findings indicate that the SFM app should be intuitive and easy to use.

G. No Cost to Users

This is concerned with the cost implication of getting the app. The three apps used in this study were “free” as it was not required for users to make any payment to acquire the app. To accommodate many consumers, it is advisable for the SFM app to have little or no cost to the users since the purpose of the app is to safeguard public health.

H. Value Add

This involves the extra pieces of useful information being delivered which is beyond the core requirements of the app. It is concerned with ensuring the app does not only achieve the purpose for which the user downloaded it in the first place but provides more value for the user. Both the text based app (TbA) and the pictures and text app (PTA) added extra value to the core functionalities of the app. The extra value was added by providing recipe information, and information about other types of meat. Therefore, the findings

indicate that a SFM app should incorporate some additional pieces of information beyond the core functionalities of the app.

In summary, the findings have revealed the benefits or positive features of all the existing apps that should be considered and perhaps incorporated into the design of the SFM app, as shown in Table 5-10. In the table, the app(s) emanating the identified benefit is highlighted by using the tick (✓) sign.

Table 5-9: Lessons learnt from existing app benefits

Benefits / Positive Features	Apps Incorporating the Features			Lessons Learned
	Text-based App (TbA)	Picture and Text-based App (PTA)	Integrated App (InA)	
Accessibility	✓	✓		Ensure fast app download
Context of picture use		✓		Ensure pictures achieve a single purpose within an appropriate context
Design and Aesthetics		✓	✓	Ensure app is visually appealing and not cluttered regardless of the information modality in focus
Information content / Functionality	✓		✓	Ensure app delivers all the required information for which the user downloaded the app.
Information Tone			✓	Ensure the instructions provided by the app are both friendly and supportive.
Locating information	✓		✓	Ensure users can easily navigate the app and find information
No Cost to Users	✓	✓	✓	It is advisable if the app is free to accommodate a broad population of users.
Value add	✓	✓		Ensure app provides some extra value, however little.

5.3.5 Themes generated from the Consumer-Based Evaluation

The themes identified in this phase of the research will be discussed and interpreted while identifying considerations worth noting for the SFM app to be developed. The connection of each axial code to the theme is described in relation to the Design of the Safe Food Management App – phase two of the research. The detailed discussion, as shown in Appendix W, is then supported by the use of interview excerpts and then linked back to the concept of each axial code. At the conclusion of each theme, the association back to the overall intent of this Phase is discussed. The themes and axial codes are discussed in a chronological manner. This phase of the research generated four themes: ACCESS, CONTENT, DESIGN and SEARCH.

5.3.5.1 Access

Access refers to the level of ease with which a SFM app can be downloaded, installed and used regardless of the smartphone being used by the consumer. The three axial codes that are incorporated into this theme are; *Accessibility*, *No Cost to Users* and *Platform Compatibility*.

Accessibility is connected to ACCESS in that it refers to the speed with which the app can be downloaded.

No Cost to Users connects to ACCESS. This is because a free app can be easily accessible by a broader population of consumers if safeguarding public health is indeed the purpose of the app.

Platform Compatibility is connected to ACCESS. An app that is platform independent is more broadly accessible by a wider spectrum of consumers.

The axial codes are discussed and interpreted in Appendix W to generate development considerations for the safe food management app.

5.3.5.2 Content

Content refers to all the considerations required when communicating and delivering information to the users through the app. The four axial codes that are incorporated into this theme are; *Ethical Perception*, *Information content/Functionality*, *Information Tone* and *Value Add*.

Ethical Perception is connected to CONTENT. For all information being delivered by the app, it is important to consider how it is ethically perceived by the consumers to facilitate its acceptance without reservations.

Information content / Functionality connects to CONTENT as it is concerned with ensuring the app contains all the actual information required by the users of the app. This ensures that the app is indeed functional and useful.

Information Tone connects to CONTENT in that it is important to consider the style or language used in communicating with the users of the app. A positive tone tends to encourage the users in following the instructions provided by the app.

Value add is connected to CONTENT. This consideration is about providing information that is just more than the required which may be useful to the users.

The axial codes are discussed and interpreted in Appendix W to generate design considerations for the safe food management app.

5.3.5.3 Design

Design refers to the artistic strategies in place that makes the app, not only visually appealing but pleasant to use. The four axial codes that are incorporated into this theme are; *Context of Picture Use*, *Context of Sound Use*, *Design and Aesthetics* and *Familiarity*.

Context of Picture Use is connected with DESIGN. Pictures or images are one of the important strategies used to make an app look attractive. However, while designing the app, it is important to ensure the pictures that will be used are appropriate and that they serve a direct goal.

Context of Sound Use connects to DESIGN. In an app, audible prompts or sounds are sometimes useful in attracting the attention of the user. However, all potential prompts or sounds must be critically assessed to ensure it achieves only the intended goal.

Design and Aesthetics is connected to DESIGN as it involves ensuring that the app is pleasant to use and attractive to the user.

Familiarity is connected to DESIGN in that it is involved with ensuring that first time users easily get acquainted with the app without much effort. This has to be built into the app during the design phase.

The axial codes are discussed and interpreted in Appendix W to generate design considerations for the safe food management app.

5.3.5.4 Search

Search refers to the factors that impact the user's ability to explore the app to retrieve the required information without wasting time or getting frustrated. The two axial codes that are incorporated into this theme are; *Layout of Information*, and *Locating Information*.

Layout of information is connected to SEARCH as it is concerned with the structure through which information is layered within the app environment. This influences the search process of the users of the app.

Locating Information connects to SEARCH. It concerns the ease with which users can explore the app for the purpose of retrieving information, thus influencing the search process within the app.

The axial codes are discussed and interpreted in Appendix W to generate design considerations for the safe food management app.

In summary, the findings from the four themes have revealed the considerations that will influence the development of the SFM app, as shown in Table 5-11.

Table 5-10: Consumer evaluation generated development considerations

Consumer Evaluation Generated Development Considerations				
S/N	Design Themes	Axial Code	App to Learn From	Design consideration(s)
1.	Access	Accessibility	TbA and PTA	1. Limit the size of the app to ensure easy download.
		No Cost to Users	All three apps	2. Consider the avoidance of cost to users.
		Platform Compatibility	PTA and InA	3. Ensure app is accessible on both iOS and Android platforms.
2.	Content	Ethical Perception	TbA and InA	4. Ensure the app does not utilise images which can emanate polarizing views such as the image of a dismembered animal.
		Information content / Functionality	TbA and InA	5. Based on findings of the survey in section 4.3, the SFM app should consider presenting tips on meat transport, storage, cooking, thawing, re-heating and kitchen hygiene. This should be based on best practice guidelines from Food Standards Australia New Zealand. However, for the selected area(s) of focus, information should be complete.
		Information Tone	InA	6. Ensure the instructions provided by the app are both friendly and supportive.
		Value Add	TbA and PTA	7. Ensure there are other useful resources.
3.	Design	Context of Picture Use	InA	8. Ensure pictures achieve a single purpose within an appropriate context. Ensure appropriate context when using picture to deliver information.
		Context of Sound Use	Not applicable	9. Avoid the use of sound cues or prompts.
		Design and Aesthetics	PTA and InA	10. Ensure app is visually appealing and not cluttered regardless of the information modality in focus. Consider using the colour scheme in InA.
		Familiarity	TbA and	11. Ensure there is an introductory / landing

			PTA	page.
4	Search	Layout of Information	InA	12. Ensure the information architecture is well-thought out.
		Locating Information	TbA and InA	13. Ensure users can easily navigate the app and find information.

5.4 Integrating Heuristic and Consumer Evaluation

As earlier discussed in section 3.3.2, Monkman and Kushniruk's Health Literacy Online Heuristics (HLOH) has been incorporated in this study (Monkman and Kushniruk, 2013). One of the reasons why this framework is very appropriate for this study is because of its focus on adoption and success of consumer health information systems but more specifically, usability and health literacy. Usability involves the interaction between the user and the interface while health literacy concerns the information content. Whilst the initial HLOH guide was created by the USA Department of Health and Human Services (USDHHS 2010) for the purpose of informing the design of health websites accessed on personal computers, it was not necessarily suitable for mobile phone applications. Therefore, Monkman and Kushniruk (2013) modified the HLOH guide for mobile phone applications and then evaluated the new guide with a mobile consumer health application. This study has incorporated the new HLOH guide re-designed by Monkman and Kushniruk.

Based on the design themes and axial codes generated in this study, the findings indicate that the some of the heuristics from the framework are aligned to some of the axial codes generated from the scenario based focus-group session. Table 5-12 reveals a modified version of Monkman and Kushniruk's framework showing how the findings in this study align with the existing literature.

Table 5-11: Integrating consumer evaluation findings with Monkman and Kushniruk's framework

Monkman and Kushniruk's HLO Heuristics			Research Generated Findings	
Usability Factor	Heuristic	Meaning	Supporting Axial Code	Design Theme
Screens	Home Screen	Have a simple and engaging home screen	Familiarity	Design
	Registration	Make registration and logging in as simple and obvious as possible	Not applicable to the selected apps and scenarios	
Content	Hierarchy	Put the most important information first	Layout of Information	Search
	Promotion	Tell users what to do and how to do it	Information Content / Functionality	Content

	Positive Tone	Stay positive and realistic. Include the benefits of taking action	Information Tone	Content
	Specific	Provide specific action steps	Information content / Functionality	Content
	Colloquial	Write in plain language	Not discussed by the participants	
	Accurate	Check content for accuracy	Not applicable to scenarios	
	Spacious	Display content clearly on the page	Design aesthetics and	Design
	Personal	Include a limited amount of interactive content that users can tailor	Information content / Functionality	Content
	Headings	Use meaningful headings	Not discussed by the participants	
	Consistency	Ensure styles are consistent	Not discussed by the participants	
Display	Font	Ensure the font is easy to read	Not discussed by the participants	
	Spacious	Use white space and avoid clutter	Design aesthetics and	Design
	Location of Content	Keep content in the centre of the screen and above the fold.	Not discussed by the participants	
	Images	Use images that facilitate learning	Context of picture use	Design
	Contrast	Use bold colours with contrast and avoid dark or busy backgrounds	Design aesthetics and	Design
	Accessibility	Make the system accessible to people with disabilities	Not applicable to the scenarios and participants	
	Topics	Put topics in multiple categories	Layout of Information	Search
Navigation	Orientation	Enable easy access to home and menu screens	Locating Information	Search
	Back Button	Make sure the “Back” button works	Not discussed by the participants	
	Linear Navigation	Use linear information paths (e.g., numbered screens)	Not discussed by the participants	
	Buttons	Simplify screen-based controls and enlarge buttons	Locating Information	Search
	Links	Label links clearly and use them effectively	Not discussed by the participants	
	Search	Include simple search and browse options.	Layout of Information	Search
	Engage	Invite users to share content and provide feedback about their experiences	Not applicable to the scenarios	
Interactivity	Print	Include printer-friendly tools and resources	Not applicable to the scenarios	
	Multimedia	Incorporate audio and visual features	Context of picture use, Context of sound	Design

			use	
	New media	Explore new media such as Twitter or text messaging	Not applicable to the scenarios	
5 Potential Heuristics Generated from the Findings				
Access	Accessibility	Limit the size of the app to ensure easy download	Accessibility	Access
	Cost	Consider the avoidance of cost to users	No cost to users	Access
	Platform compatibility	Ensure app is accessible on multiple platforms	Platform compatibility	Access
Content	Ethical perception	Do not use images or contents which could emanate polarizing views	Ethical perception	Content
	Value add	Ensure there are other useful resources apart from the core requirements	Value add	Content

With reference to the modified HLOH framework, five potential heuristics have been identified, which were not initially in Monkman and Kushniruk's framework. These are; Accessibility, Cost, Platform Compatibility, Ethical Perception and Value Add. The five potential heuristics have been identified from the findings of this study in section 5.3. However, it is imperative to compare the findings of the heuristics evaluation of the three existing apps with user-generated evaluation.

As presented in section 5.3.2, the findings of the heuristics evaluation of the three existing apps (TbA, PTA and InA) based on the HLO heuristics has revealed the assessment of the three apps from the perspective of the investigator based on Monkman' and Kushniruk's framework (see section 5.3.2, Table 5-1 and Appendix K). As specified in section 5.3.2, the heuristic evaluation used a three-level severity scale with numbers 1, 2 and 3 representing mild, moderate and severe respectively. However, the consumer evaluation was based on the presence of issues or absence of benefit specified by a cross (✖) while the presence of benefit or absence of issue is specified by a tick (✓) as shown in Table 5-13.

Table 5-12: Comparing findings between heuristic evaluation and consumer evaluation

Heuristics and/or (Supporting Axial Code)	Heuristics Evaluation (HE) Results	Consumer Evaluation (CE) Results	Justifying Discrepancy
Home Screen	TbA = 2	TbA = ✓	Findings from the HE reveal that the TbA home screen is simple but not necessarily

(Familiarity)	PTA = ✓ InA = 3	PTA = ✓ InA = ✗	engaging. However, for CE, participants did not complain.
Hierarchy (Layout of Information)	TbA = ✓ PTA = ✓ InA = 1	TbA = ✗ PTA = ✗ InA = ✓	Whilst findings from HE reveal that TbA and PTA have an appropriate hierarchy of information, CE proved otherwise. Perhaps, this is due to the scenario-based usability evaluation session which forced the participants to use the app, as they would use it in a real-life context. This method has retrieved rich findings missed out by the HE. For InA, it was only a mild issue identified by HE.
Promotion (Information Content / Functionality)	TbA = 1 PTA = ✓ InA = ✓	TbA = ✗ PTA = ✗ InA = ✓	HE did not identify promotion as an issue for PTA as the instructions appeared clear enough for the user. However, as CE utilised a broad spread of different types of users, it was able to capture this finding which would have been missed otherwise.
Positive Tone (Information Tone)	TbA = 3 PTA = 3 InA = ✓	TbA = ✗ PTA = ✗ InA = ✓	The findings for both HE and CE here are well aligned.
Specific (Information Content / Functionality)	TbA = ✓ PTA = ✓ InA = ✓	TbA = ✗ PTA = ✗ InA = ✓	Findings from HE reveal that TbA and PTA provide specific action steps for the user. However, CE proved otherwise. Perhaps, this is due to the scenario-based usability evaluation session which forced the participants to use the app, as they would use it in a real-life context. This method has retrieved rich findings missed out by the HE.
Spacious (Design and Aesthetics)	TbA = 3 PTA = ✓ InA = ✓	TbA = ✗ PTA = ✓ InA = ✓	The findings for both HE and CE here are well aligned.
Personal (Information Content / Functionality)	TbA = 3 PTA = 2 InA = ✓	TbA = ✗ PTA = ✗ InA = ✓	The findings for both HE and CE here are well aligned.
Images (Context of Picture Use)	TbA = N/A PTA = 1 InA = ✓	TbA = ✗ PTA = ✗ InA = ✓	In HE, TbA was not assessed for this heuristic because it was only examined for the textual properties based on the focus of its information modality. However, CE discovered that the background picture

			was distracting.
Contrast (Design and Aesthetics)	TbA = 1 PTA = 1 InA = ✓	TbA = ✗ PTA = ✗ InA = ✓	The findings for both HE and CE here are well aligned.
Topics (Layout of Information)	TbA = ✓ PTA = 1 InA = 1	TbA = ✗ PTA = ✗ InA = ✓	Whilst findings from HE reveal that the topics are appropriately categorized, CE proved otherwise. CE was able to identify the difficulty faced in finding information due to the information structure. As CE utilised a broad spread of different types of users, it was able to capture this finding which would have been missed otherwise.
Orientation (Locating Information)	TbA = ✓ PTA = 2 InA = 1	TbA = ✓ PTA = ✗ InA = ✓	The mild issue identified by HE on InA concerns the absence of the swipe effect to be able to access the home and menu screens. However, for CE, participants did not complain as they could access it through other means.
Buttons (Locating Information)	TbA = 1 PTA = ✓ InA = ✓	TbA = ✓ PTA = ✗ InA = ✓	For TbA, HE identified that one of the home buttons was too close to an ad thus causing the user to go to the unintended page. However, for CE, participants did not complain. For PTA, CE was able to identify the problem with the main menu. As CE utilised a broad spread of different types of users, it was able to capture this finding which would have been missed otherwise.
Search (Layout of Information)	TbA = 3 PTA = ✓ InA = 3	TbA = ✗ PTA = ✗ InA = -	HE did not identify search as an issue for PTA as the evaluation criteria aimed at ensuring the existence of simple search and browse options which is different from ensuring it works adequately. In this case, CE was able to identify the problem with the search button which would have been missed otherwise.
Multimedia (Context of Picture use)	TbA = - PTA = 1 InA = ✓	TbA = ✗ PTA = ✗ InA = ✓	In HE, TbA was not assessed for this heuristic because it was only examined for the textual properties based on the focus of its information modality. However, CE discovered that the background picture was distracting.
Multimedia (Context of Sound use)	TbA = - PTA = 1	TbA = - PTA = ✓	Whilst the PTA app, incorporated visual features, it did not incorporate audio features. For this heuristic, HE did not identify the problem with the sound

InA = ✓	InA = ✗	feature. However, CE was able to identify the problem perhaps, due to the scenario-based usability evaluation session which forced the participants to use the app, as they would use it in a real-life context. This method has retrieved rich findings missed out by HE.
---------	---------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

It must however be noted that the five potential heuristics generated from the consumer evaluation of the existing apps cannot be compared with the findings of the heuristics evaluation of the apps in Table 5-13 as there is no relationship between them. The findings in Table 5-13 indicate that the four heuristics which have generated well-aligned findings for all three apps are; Positive Tone (Information Tone), Spacious (Design and Aesthetics), Personal (Information Content / Functionality) and Contrast (Design and Aesthetics). On the other hand, the heuristic evaluation conducted was able to identify a moderate issue with the TbA's home screen (familiarity), InA's orientation (Locating Information) and TbA's buttons (Locating Information) while the consumer evaluation could not identify those issues as participants did not complain.

But more importantly, the findings reveal that the consumer evaluation was able to identify problems in one or two of the apps which heuristics the evaluation could not identify. The nine heuristics that revealed in-depth and richer findings in the apps, through the consumer evaluation, are as follows; Hierarchy (Layout of Information), Promotion (Information Content / Functionality), Specific (Information Content / Functionality), Images (Context of Picture Use), Topics (Layout of Information), Buttons (Locating Information), Search (Layout of Information), Multimedia (Context of Picture use) and Multimedia (Context of Sound use). Therefore, these findings suggest that the consumer evaluation provided in-depth insights and rich findings on the usability of the existing apps. However, based on the issues identified with the TbA's home screen (familiarity), InA's orientation (Locating Information) and TbA's buttons (Locating Information), the following additional design considerations have been made as shown in Table 5-14.

Table 5-13: Heuristics evaluation generated design considerations

Heuristics	Supporting Code	Development considerations
Home Screen	Familiarity	14. Ensure the Home Screen is not only simple but also engaging.
Orientation	Locating Information	15. Consider including the swipe effect for easy access to the home and menu screens
Buttons	Locating Information	16. If the ads are not avoidable, ensure they are not close to buttons.

Based on both the design considerations generated from the heuristic evaluation and consumer evaluation, the concept design for the app is presented in the next sub-section.

5.5 Concept Design

As earlier discussed in section 5.3.1, there is evidence to suggest that a high-fidelity prototype/fully functional prototype provides a more valid evaluation than a paper or low fidelity prototype (Lim et al. 2006). Thus, the existing apps have been used as a high fidelity prototype as it provides more effective collection of true human performance data. There is also a precedent for this type of approach in developing mobile solutions using existing applications (Fleury et al. 2010). Therefore, based on the findings from the heuristic and consumer evaluations conducted on all three apps (TbA, PTA and InA), this section provides a finalised high fidelity prototype; having learnt from user preferences and experiences with the existing apps. It must however be noted here that careful considerations have been made to ensure that ethical restrictions on the existing apps used for this study have been strictly adhered to during the development of this finalised high fidelity prototype. The details of the concept design, in terms of the app content, app platforms, home screen, preparation or cooking information, important safe preparation tips, guide to correct cooking temperatures, special rules for barbecues, specific cooking help, reheating left overs and meat thermometers are shown in Appendix X.

5.6 Developing the Safe Food Management App

Using the insights generated from sections 5.3, 5.4 and 5.5, the app has been developed on both the iOS and Android platforms. This was done between December 2015 and February 2016. The researcher closely worked with two mobile application developers

to facilitate the development of the app on each platform. This involved refining the app on several occasions to ensure the apps were similar despite the differences of the affordances of the functionalities of both platforms. Figures 5-12 and 5-13 show the same page on Android and iOS platforms respectively.

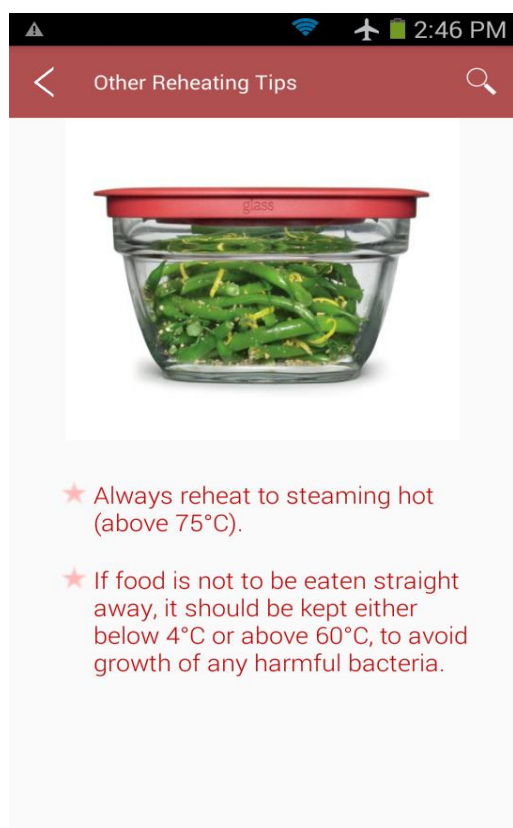


Figure 5-7: Android version



Figure 5-8: iOS version

To download the app, the following links or QR codes can be used;

Android Version: <https://play.google.com/store/apps/details?id=com.adeola.tams>



Figure 5-9: QR code link to the Android version of the app

iOS Version: <https://itunes.apple.com/au/app/australian-meat-safety/id1095451744?mt=8>



Figure 5-10: QR code link to the iOS version of the app

5.7 Phase Two – Initial Findings

The focus of phase two was to design and develop a safe food management app by learning from existing apps and understanding whether there are differences in how safe food management apps should be designed when compared to generic app design principles. This was done by combining health literacy online heuristics (HLOH) framework with a consumer-based evaluation to holistically assess the existing applications.

The initial findings of Phase Two of the research are classified into three key points. First, a safe food management app was successfully developed based on a non-conventional software methodology by leveraging on the insights generated from the HLOH framework (Monkman and Kushniruk, 2013) as well as the consumer-based evaluation. Thus, the research utilised outputs from both modes of usability evaluations as inputs for the design and development of the app. This is an uncommon approach to app development as usability evaluations usually only occur after the app has been developed in the app development lifecycle (Inukollu et al., 2014). The approach has revealed insights into the usefulness of a proactive approach to application development

which has the potential to significantly reduce the design and development time and by extension cost, when compared to a reactive approach which focuses on only the output of the developed app.

Second, this phase has identified five important principles that must be considered in addition to the existing generic mobile app design principles (Monkman and Kushniruk, 2013, Gong and Tarasewich, 2004, Fling, 2009) when designing safe food management apps. These include;

1. **Context Appropriate Images:** This principle is concerned with the use of images that are appropriate from the perspective of food consumers, who are also the app users. Specifically, it is important that the app does not include images that can emanate polarizing views such as the image of a dismembered animal. An image may be suitable for the purpose of conveying a message to the app users but care must be taken to ensure other unintended, offensive or confusing messages are not sent to the users. Therefore, the choice of an image must be well thought-out using a broad lens to capture the diversity of perception of the intended users.
2. **Added Value:** This principle refers to the provision of other useful resources in the app, apart from its primary focus. The purpose of these resources may be for the provision of additional information, convenience to the user, context relevant support, technical support or for networking. Whilst these resources are not the primary focus of the app, they must however be relevant to the app's purpose without being overpowering. Thus, there must be a good balance.
3. **Pictures with Unilateral Purpose:** This principle involves the use of pictures that achieve a single purpose within an appropriate context. This includes ensuring that only the appropriate context is alluded to when using picture to deliver information. Pictures may pass across an educational message, a psychological message, an emotional message, other messages or a mixture of some or all of these messages. Therefore, utmost care must be taken to ensure the chosen picture in fact delivers the intended message to the users of the app.
4. **Avoidance of Sound Prompts:** This principle is concerned with the absolute avoidance of the use of sound cues or prompts when communicating information on safe food management. This is important because it is regarded as a source of distraction,

thus detracting from the focus of the app. Other modalities of information such as graphics, videos, animations and little amount of texts can be used to communicate information in a more positive manner.

5. **Aesthetically pleasing:** This principle refers to the ‘look and feel’ of the app as it must be visually appealing and not cluttered regardless of the information modality in focus. Whilst this principle might appear generic, it however focuses on the balance required in the choice and use of multiple information modalities on the pages of the app. It is common knowledge that text-based information only is not aesthetically pleasing but this does not guarantee that other information modalities such as graphics, videos and animations are visually appealing regardless of how they are placed on the app pages. Indeed, great attention has to be given to all these information modalities in terms of features such as the layout, colours, image sizes, brightness, audio tone and the responsiveness of the design (portrait versus landscape across multiple devices) to ensure that the app design is visually appealing to the users.

Third, the identified principles for food safety app designs stemmed from the uniqueness of the safe food management context, which this research has uncovered, in three ways; *the context of use, the need for sustainability of acquired knowledge and the consequences of poor decisions due to poor knowledge.*

1. **Context of use:** As meat is a major source of concern, many food safety interventions, but more specifically, food safety apps tend to focus on educating consumers on how meat products should be handled. With education the primary aim, the use of meat images in food safety apps should be considered with caution. As such, when developing food safety apps, how meat images are represented must be considered by ensuring the app does not utilise images which can emanate polarizing views such as the image of a dismembered animal as stated by principle 1 above.

2. **Need for sustainability of acquired knowledge:** The need for sustainability of acquired knowledge refers to end-to-end safe food management apps that are not necessarily reliant on procedural knowledge as they require an understanding of the safety process from the point of purchase to the point of actual consumption. In the five-stage domestic food handling process, consumers (end users) have to understand how to safely undergo the entire process and retain the knowledge for its actual implementation

across the stages. As such, it is unrealistic for end-users to continually use apps during most of the five-stage processes (transportation, preparation and kitchen hygiene). Therefore, apps should be designed with the intention to reduce technology dependency during the five-stage process of safe food handling by consumers. This aims to ensure that the end users understand the app content and can retain the knowledge acquired over time (sustainability) after using the app for the first few times.

3. **Consequences of poor decisions due to poor knowledge:** The associated risks with unsafe food management from consumers' point of purchase to the point of actual consumption could indeed lead to unpleasant outcomes. As such, apps developed for the purpose of safe food management are important due to the serious consequence of poor decisions caused by lack of knowledge.

Therefore, these five principles will enhance the HLOH framework to make it more robust and comprehensive for it to address the uniqueness of the safe food management context. Whilst the HLOH framework consists of principles that could enhance the usability of m-Health apps, it is however limited in its ability to capture the nuances of the food safety context in terms of the context of use, the need for sustainability of acquired knowledge and the consequences of poor decisions due to poor knowledge. This research has filled this gap by identifying these nuances, acknowledging their existence and by discovering 5 usability principles that must be added to the existing HLOH framework for it to be relevant and useful to the other user experience researchers, designers, and developers that aim to develop consumer-focused apps within the food safety domain. The efficacy of these additional principles must however be tested in future larger quantitative studies to identify moderating and mediating variables that influence this assertion. This future work may also test the appropriateness of the enhanced framework to other domains.

5.8 Chapter Summary

This chapter has presented the data analysis that was conducted for the Design and Development of the Safe Food Management App, which is the phase two of the research and the associated preliminary findings. As the aim of this phase was to identify the impact of the three information modalities on consumer understanding and to understand

users preferred method of information presentation in an app, the findings have provided rich insights into consumer preferences for a safe food management app. First, the problems with the existing apps utilised for the conduct of the research were identified. Based on these issues, 10 lessons were learnt. Second, the benefits or positive features with the existing apps utilised for the conduct of the research were identified. Based on these issues, 8 lessons were learnt.

Furthermore, the findings of the heuristics evaluation and the consumer evaluation were integrated to generate richer findings. Whilst some of the findings were aligned, many were missed out by the heuristics evaluation conducted. The nine heuristics that revealed in-depth and richer findings in the apps through consumer evaluation are as follows; Hierarchy (Layout of Information), Promotion (Information Content / Functionality), Specific (Information Content / Functionality), Images (Context of Picture Use), Topics (Layout of Information), Buttons (Locating Information), Search (Layout of Information), Multimedia (Context of Picture use) and Multimedia (Context of Sound use). Thus, the 10 lessons learnt from the issues with the existing apps, 8 lessons learned from the benefits of the existing apps, were integrated to generate 16 distinct design considerations or principles out of which 5 principles appear unique to the safe food management context.

These considerations have led to the development of the SFM smartphone application for educating and empowering consumers on the five safe food management practices identified from the survey in Phase 1 as problematic (cooking, kitchen hygiene, storage, reheating and transportation). An additional construct - shopping was added to the five constructs in order to provide extra value (see design and development consideration 7) for the users of the app as it was deemed relevant for the context being addressed.

Therefore, having learnt from the existing safe meat cooking apps, the safe food management app has been developed in this phase (Phase 2). However, to determine whether the app indeed empowers consumers to optimise their safe food management knowledge, the next phase (Phase 3) implements and evaluates the app to investigate how it influences consumer knowledge acquisition, knowledge retention and perceived behavioural change. Thus, the next chapter presents the data analysis and preliminary findings of the phase three of this research – Implementing and Evaluating the Safe Food Management App.

CHAPTER SIX

**DATA ANALYSIS AND PRELIMINARY FINDINGS:
IMPLEMENTATING AND EVALUATING
THE SAFE FOOD MANAGEMENT APP**

6 DATA ANALYSIS AND PRELIMINARY FINDINGS: IMPLEMENTING AND EVALUATING THE SAFE FOOD MANAGEMENT APP

6.1 Introduction

This chapter describes the data analysis of the phase that focuses on implementing and evaluating the safe food management (SFM) smartphone application (app). In phase two, the safe food management app was designed and developed based on lessons learnt from the existing safe meat cooking apps. However, to determine whether the app indeed empowers consumers to optimise their safe food management knowledge, this phase (Phase 3) implements and evaluates the app.

Thus, the focus of this phase involved the use of a field experiment to investigate how the use of the app influences consumer knowledge acquisition, knowledge retention and perceived behavioural change. This research activity aimed to provide answers to the third research question. The data analysis follows the method detailed in section 3. In this chapter, the findings of the field experiment (see section 3.3.3) are presented, discussed and interpreted. This covers the analysis of the collected data, through face-to-face closed and open-ended questionnaires on safe food handling knowledge from participants across a period of 4 weeks. The data set was analysed using two different approaches. The closed-ended questionnaire was statistically analysed in order to create a range of descriptive statistical diagrams and tables while the open-ended questionnaires were manually analysed. Next, the chapter discusses the impact of the activities that occurred in each week of the experiment. It progresses by integrating and discussing the results of the experiment across the 4 week period. Following this, it discusses the level, and the impact, of the usage of the smartphone app over the period of the experiment before providing a picture of how the experiment influenced each participant 6 weeks after the experiment which leads to the conclusion of the chapter.

It is however important to note that this chapter only presents the findings of Phase 3 of the study. The findings presented here in Chapter 6 are discussed and interpreted in light of extant literature in Chapter 7.

This chapter is divided into the following sections:

- Section 6.2 presents the demographic characteristics of the participants in the field experiment.
- Section 6.3 presents the results for each week of the experiment. This includes: Week One of the experiment, which focuses on the pre-existing knowledge of the participants using closed ended questionnaire; Week Two of the experiment, which focuses on the participants' demonstration of 'remembering' using closed ended questionnaire; Week Three of the experiment, which focuses on the participants' demonstration of 'understanding' using open ended questionnaire; Week Four of the experiment, which focuses on the participants' demonstration of 'knowledge application' using open ended questionnaire and post-experiment assessment six weeks after the experiment using both closed and open ended questionnaires.
- Section 6.4 provides a clear picture of how the experiment has influenced each of the eight participants across the experiment.
- Section 6.5 discusses the results in relation to the acquisition of information and/or knowledge by the participants. This spans the research activities that occurred between Week One and Week Two.
- Section 6.6 discusses the results in relation to the level of understanding the participants have acquired based on the information provided to them in the previous weeks. This focuses on the research activities that occurred between Week Two and Week Three.
- Section 6.7 discusses the results in relation to the level of knowledge the participants have retained and can apply based on the information provided to them in the previous weeks. This focuses on the research activities that occurred between Week Three and Week Four.
- Section 6.8 discusses the level of, and the impact of, the usage of the smartphone app over the period of the experiment.
- Section 6.9 discusses the preliminary findings of phase three of the research.
- Section 6.10 provides a summary of the chapter.

6.2 Demography of the Participants

This sub-section presents the demographic data of the participants. All the respondents live in Hobart, Tasmania, Australia and they are above 18 years of age. As discussed in section 3.3.3, the participants were divided into two groups; experimental group (app users) and control group (paper-based tool users). Each group was randomly selected based on gender and age.

First, one important criterion for each potential participant to fulfil is the ability to purchase, cook and eat meat which is generally about food preparation in the home. There is evidence to support the argument that food preparation is a strongly gendered household task (Blake et al., 2009, Hartmann et al., 2013). In agreement, Worsley et al. (2014) have argued that cooking remains a female responsibility in Australia, thus portraying the importance of **gender** in this study. Second, the other criterion that must be fulfilled by each potential participant is the ownership and use of smartphones. There is also evidence to support the argument that electronic channel preferences through the use of smartphones is more preferred by a younger class of Australians (Worsley et al., 2014), thus portraying the importance of **age** group as well.

During the 4-week experiment, eight candidates (4 males and 4 females) participated in the research and the candidates were split into 2 groups of four based on their gender and age as shown in Tables 6-1 and 6-2;

Table 6-1: Experimental group (app users)

Participant	Age group	Gender	Code Name
Candidate 5	30 - 49	Male	ACM
Candidate 4	30 - 49	Female	ACH
Candidate 1	50 +	Male	ACJ
Candidate 7	50 +	Female	ACC

The highest educational qualification of candidates 1, 4 and 5 is Bachelor or higher, while candidate 7 has a Diploma or Advanced Diploma.

Table 6-2: Control group (Document users)

Participant	Age group	Gender	Code Name
Candidate 6	18 - 29	Male	DCH
Candidate 3	30 - 49	Female	DCV
Candidate 8	30 - 49	Male	DCW
Candidate 2	50 +	Female	DCT

All candidates within the control group have a Bachelor or higher educational qualification.

6.2.1 Smartphone Usage

This sub-section discusses the level at which the participants are familiar with the use of smartphones, as this helps to understand the level of accessibility to the object of investigation. The two groups discussed here are the experimental group and the control group.

6.2.1.1 Experimental Group

All participants within the experiment group own and use a smartphone. 50% of the participants are Android phone users while the others use iOS-based phones. 50% of the participants have been using a smartphone for more than 4 years while the others have been using smartphones for more than 2 years but less than 4 years. To investigate their level of familiarity with the smartphone currently in use by the participants, it was revealed that 50% of the participants have been using their current phone for more than 1 year but less than 2 years; 25% for more than 2 years but less than 4 years; and 25% for more than 6 months but less than 1 year. 50% of the participants consider themselves medium smartphone users, 25% regard themselves as light users while 25% believe they are heavy users. To have a better understanding of what each participant meant by ‘light’ or ‘heavy’, they were asked to specify how long they typically use their smartphones in a day. The ‘medium’ users spend 1 to 2 hours, light users spend less than 1 hour and heavy users spend 3 to 4 hours on their smartphones in a day. The most frequently used

apps of the participants are Instagram, Apple weather, YouTube and Words with Friends.

Therefore, it is reasonable to state that these participants are familiar with the use of smartphones and mobile phone apps. Thus, suggesting that they will be able to easily access an app presented to them in the course of the experiment.

6.2.1.2 Control Group

All participants within the control group own and use a smartphone. 75% of them are iOS-based phone users while the others use Android phones. 75% of them have been using a smart phone for more than 4 years while the others have been using smartphones for more than 2 years but less than 4 years. To investigate their level of familiarity with the smartphone currently in use by the participants, it was revealed that 50% of the participants have been using their current phone for more 4 years; 25% for more than 2 years but less than 4 years; and 25% for more than 6 months but less than 1 year. 50% of the participants consider themselves medium smartphone users, 25% regard themselves as light users while 25% believe they are very heavy users. To have a better understanding of what each participant meant by 'light' or 'very heavy', they were asked to specify how long they typically use their smartphones in a day. The 'light' users spend less than 1 hour, 'very heavy' users spend more than 4 hours while one of the 'medium' users spend 1 to 2 hours on their smartphones in a day. The other 'medium' user however spends less than 1 hour on the smartphone in a day which corresponds to a 'light' user. The most frequently used apps of the participants are Skype, 4 Pics 1 Word, Here Drive, ABC News and Google maps.

All candidates within this group have a Bachelor or higher educational qualification. This is very important as it suggests that the participants are learned and they can easily access, read and understand text presented to them in the course of the experiment.

6.2.2 Food Handling

For the experimental group, all participants have mixed diet which includes red meat and white meat, which shows that none of them are vegetarians or vegans. 50% of them purchase their meat products from supermarkets, 25% from fresh food markets and 25% from delicatessens. All participants within this group cook raw meat products at least once a week. Therefore, this shows that the participants within this group are food handlers in their homes.

For the control group, 75% of the participants have mixed diet which includes red meat and white meat, but 25% have mixed diet which includes only red meat. This shows that none of them are vegetarians or vegans. 75% of them purchase their meat products from supermarkets and 25% from fresh food markets. 75% of the participants within this group cook raw meat products at least once a week while others cook raw meat products at least once a fortnight. Therefore, this shows that the participants within this group are food handlers in their homes.

6.3 Field Experiment Findings

This section presents the findings for each week of the field experiment which was conducted to evaluate participants' level of knowledge acquisition, knowledge retention and knowledge application. This is followed by the assessment conducted six weeks after the completion of the 4-week experiment, to assess participants' perceived behavioural changes.

6.3.1 Field Experiment – Week One

As discussed in section 3.3.3, the baseline questionnaire (pre-test) is based on existing research instruments for evaluating consumers safe food handling knowledge from the works of Gong et al. (2016), Hassan and Dimassi (2014), Lazou et al. (2012), Byrd-Bredbenner et al. (2007) (*see Appendix C*) which has been validated. There were 20 questions and each participant in both groups was told to select the most correct answer based on their current knowledge. Each question represents one point. The findings are as shown in Figure 6-1.

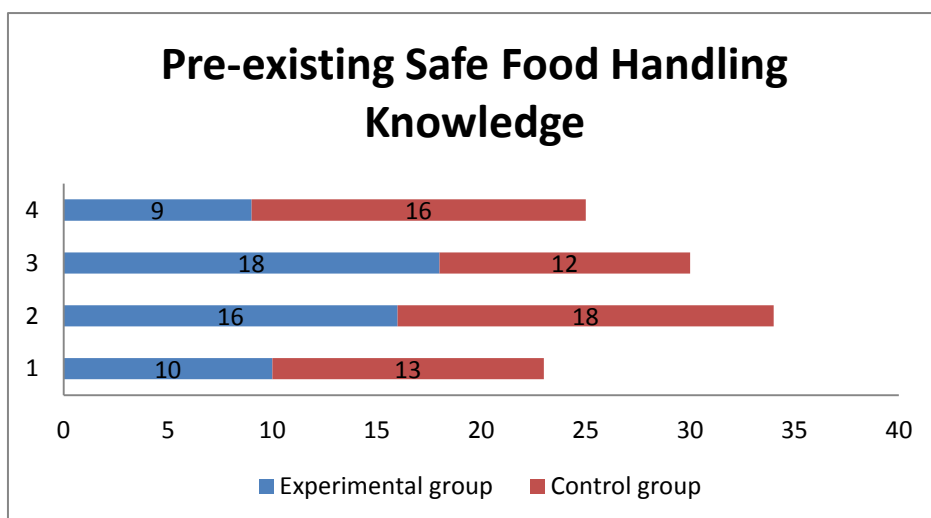


Figure 6-1: Pre-existing safe food handling knowledge

The mean score of the experimental group was 13.25, while the mean score for the control group was 14.75. This reveals that participants in the control group had a better pre-existing knowledge of safe food handling in the home when compared to the experimental group.

On the completion of this task, participants in the experimental group were given instructions to download the app on their phones while participants in the control group were given the paper-based tool. The paper-based tool had exactly the same content as the app; however, it was text-based only. Care was taken to ensure the participants in the control group did not have access to the app while those in the experimental group did not have access to the paper-based tool.

Following this, all the participants underwent the information and/or knowledge acquisition process. First, this was done by providing another copy of the baseline questionnaire to all the participants and they were asked to use the app or paper-based tool provided to locate the correct answers from the app (for the experimental group) or from the paper-based tool (control group). Second, the researcher and an experienced facilitator worked with both the experimental and control group respectively, to facilitate a brainstorming session about the factual information obtained from app and paper-based tool. The aim of the group discussion was to achieve the following;

- To ensure each person talks about what was learnt so far
- To help those who did not find one answer or the other
- To ensure actual learning takes place
- To ensure they all have the right answer to the questions

Subsequently, the participants were told to revise their information and/or knowledge acquisition tool before the next session which occurred in the following week.

6.3.2 Field Experiment – Week Two

As discussed in section 3.3.3, the follow up questionnaire (post-test 1) is exactly the same as the baseline questionnaire but the only difference is that the questions and answer options are re-ordered. Therefore, there were 20 questions and each participant in both groups was told to select the most correct answer based on their current knowledge. Each question represents one point. The findings are as shown in Figure 6-2.

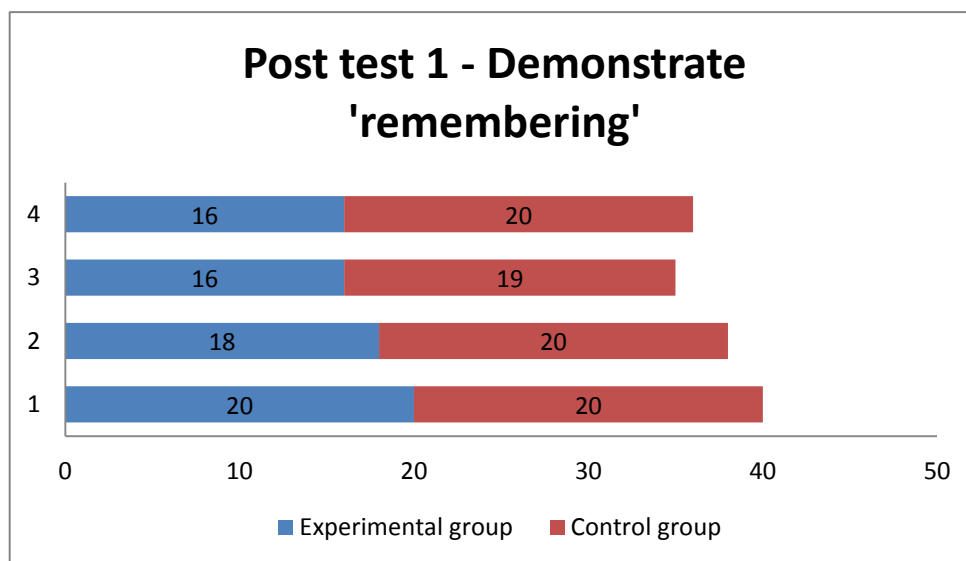


Figure 6-2: Post-test 1: To demonstrate 'remembering'

The mean score of the experimental group was 17.5, while the mean score for the control group was 19.75. This reveals that participants in the control group were able to remember what was learnt in the previous week better than the experimental group.

In addition, participants were asked questions about their use of the app (for experimental group) and paper-based tool (for control group) provided to them between Week One and Week Two. Tables 6-3 and 6-4 reveal the findings.

Table 6-3: App usage between Week 1 and Week 2

Experimental Group	ACJ	ACC	ACH	ACM
Revised app?	Yes	Yes	Yes	Yes
Number of times	1	3	2	2
For each revision, how long?	5 - 10 mins	5 - 10 mins	5 - 10 mins	10 - 15 mins
Sharing of knowledge acquired?	No	No	Yes	Yes
Mode of knowledge sharing	Not applicable	Not applicable	1. Discussing it. 2. Showing someone the app	1. Discussing it

Table 6-4: Paper-based tool usage between Week 1 and Week 2

Control Group	DCW	DCT	DCV	DCH
Revised document?	No	Yes	No	Yes
Number of times	Not applicable	2	Not applicable	1
For each revision, how long?	Not applicable	5 - 10 mins	Not applicable	Less than 5 mins
Sharing of knowledge acquired?	Yes	Yes	No	No
Mode of knowledge sharing	1. Discussing it	1. Discussing it. 2. Sharing it on social media	Not applicable	Not applicable

The results therefore reveal that the participants in the experimental group were more inclined to use the app during the week. Participants in the control group were not keen on using the paper-based tool to revise the safe food handling resource provided to them. However, there was no significant difference in the results regarding the sharing of knowledge they had acquired in the previous week.

6.3.3 Field Experiment – Week Three

In week three, the participants were presented with scenario based questions that were drawn from, and strongly aligned to, the baseline questionnaire in Week One (see Appendix D for scenario based questionnaires). The focus of this week was for the participants to demonstrate their understanding of the acquired information in the

previous weeks. Due to the nature of the questions, all participants were asked about their familiarity with the use of a recipe resource such as recipe books, online recipes, TV shows, cooking classes, friends and family. The results reveal that all participants had used at least recipe books and online recipes more than 10 times in the past. Therefore, the format of the scenarios would appear familiar to them. There are 4 scenarios, with one scenario for each question. Each question is assigned 5 points and points are allocated to each participant based on the correctness of their response. The answers for each question are drawn from the smartphone app or paper-based tool which was provided to the participants in the previous weeks. Details of the results of the open-ended questions for questions 1, 2, 3 and 4 for the experimental group and control group are presented in Appendix Y.

For the first question (*clearly describe two different methods of avoiding cross contamination between the lamb chops and the vegetables*), participants in the experimental group showed better understanding when compared with those in the control group. For the second question (*clearly describe all the steps you would take to preserve the meal till your friend arrives and is ready to eat*), participants in the control group showed better understanding when compared with those in the experimental group. For the third question (*clearly describe all the steps you would take to store the leftover lunch and the raw chicken in your fridge while ensuring the safety of the leftover*), participants in the experimental group showed better understanding when compared with those in the control group. For the fourth question (*clearly describe all the steps you would take to ensure your hands are clean before you roll the wraps*), participants in the control group showed slightly better understanding when compared with those in the experimental group (See Appendix Y for details). However, based on the points acquired by each individual in each group, Figure 6-3 reveals the overall level of understanding of the participants.

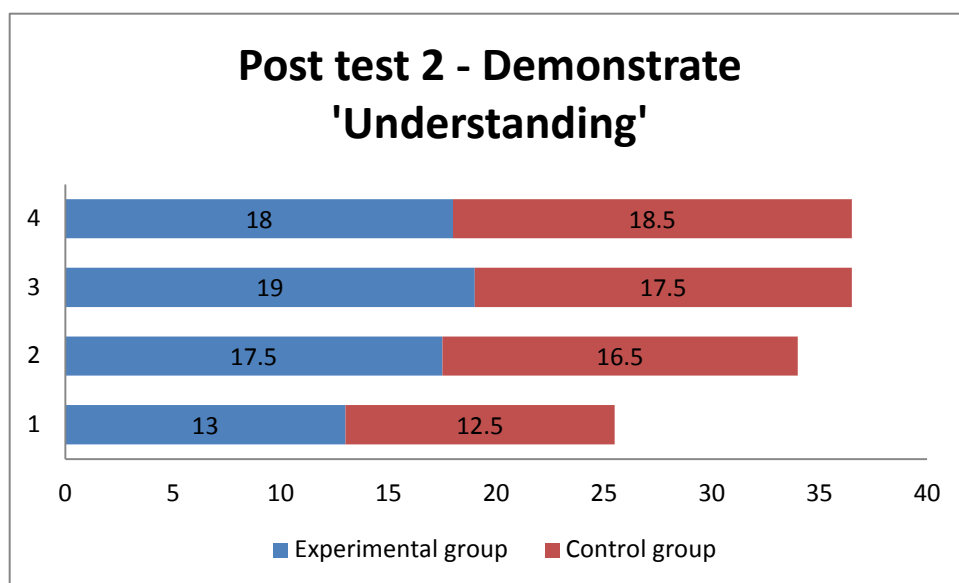


Figure 6-3: Post-test 2: To demonstrate 'understanding'

The mean score of the experimental group was 16.875, while the mean score for the control group was 16.25. This reveals that participants in the experimental group were able to demonstrate a slightly better understanding of what was learnt in the previous weeks better than the control group.

In addition, participants were asked questions about their use of the information and/or knowledge acquisition tool (*app* for *experimental group* and *paper-based tool* for *control group*) provided to them between Week Two and Week Three. Tables 6-5 and 6-6 reveal the findings.

Table 6-5: App usage between Week 2 and Week 3

Experimental Group	ACJ	ACC	ACH	ACM
Revised app?	No	Yes	Yes	Yes
Number of times	Not applicable	1	1	1
For each revision, how long?	Not applicable	5 - 10 mins	5 - 10 mins	5 - 10 mins
Sharing of knowledge acquired?	No	No	No	Yes
Mode of knowledge sharing	Not applicable	Not applicable	Not applicable	1. Discussing it. 2. By correcting someone's food handling practice

Table 6-6: Paper-based tool usage between Week 2 and Week 3

Control Group	DCW	DCT	DCV	DCH
Revised document?	No	Yes	No	Yes
Number of times	Not applicable	3	Not applicable	1
For each revision, how long?	Not applicable	5 - 10 mins	Not applicable	5 - 10 mins
Sharing of knowledge acquired?	Yes	Yes	No	No
Mode of knowledge sharing	1. Discussing it	1. Discussing it.	Not applicable	Not applicable

The findings therefore reveal that the participants in the experimental group were more inclined to use the app during the week. Participants in the control group were not keen on using the document to revise the safe food handling resource provided to them. However, they were more inclined to share the knowledge they had acquired in the previous weeks by discussing it.

6.3.4 Field Experiment – Week Four

In week four, the participants were presented with open-ended questions based on real scenarios presented to the participants in a kitchen environment. The questions were drawn from, and strongly aligned to, the baseline questionnaire in Week One (see Appendix E for Questions on Real Scenarios in a Kitchen Environment). The focus of this week was for the participants to apply the knowledge they had acquired in the previous weeks. There were four scenarios, with one scenario for each question. For each scenario, a table is presented to each participant with a certain arrangement of food products to support the question being posed (see Appendix P for Experiment Exhibits for each Table). Each question is assigned 5 points and points were allocated to each participant based on the correctness of their response. The answers for each question were drawn from the app or paper-based tool which was provided to the participants in the previous weeks. Details of the results of the open-ended questions for questions 1, 2, 3 and 4 for the experimental group and control group are presented in Appendix Z.

For the first question (*Critically examine Table A. You want to use the knife and chopping board to cut the snow peas, tomatoes and the onions. Clearly describe all the*

steps you will take to ensure you avoid cross contamination), participants in the control group were slightly better in applying the acquired knowledge when compared with those in the experimental group. For the second question (*Critically examine Table B and read through the information provided about the chicken. Is it safe to eat the chicken? Why?*), participants in the control group were slightly better in applying the acquired knowledge when compared with those in the experimental group. For the third question (*Critically examine Table C. You have finished cutting the pork into smaller pieces. You have washed your hands with warm soapy water for 30 seconds and you have perfectly dried your hands with the kitchen towel on the table. a. Have you cleaned your hands in accordance with best practice guidelines? b. Please give a significant reason to justify your answer in “a” above.*), participants in the experimental group were much better in applying the acquired knowledge when compared with those in the control group. For the fourth question (*Critically examine the fridge at station D. a. Examine the fridge, the container labelled “uncooked premium Tasmanian salmon” and the container labelled “garden salad”. Is the storage arrangement of those 2 items in accordance with best practice? b. Please give a minimum of 4 reasons to justify your answer in “a” above.*), participants in the experimental group were much better in applying the acquired knowledge when compared with those in the control group (See Appendix Z for details). In addition, based on the points acquired by each individual in each group, Figure 6-4 reveals the overall level at which the participants were able to apply their knowledge to the given context.

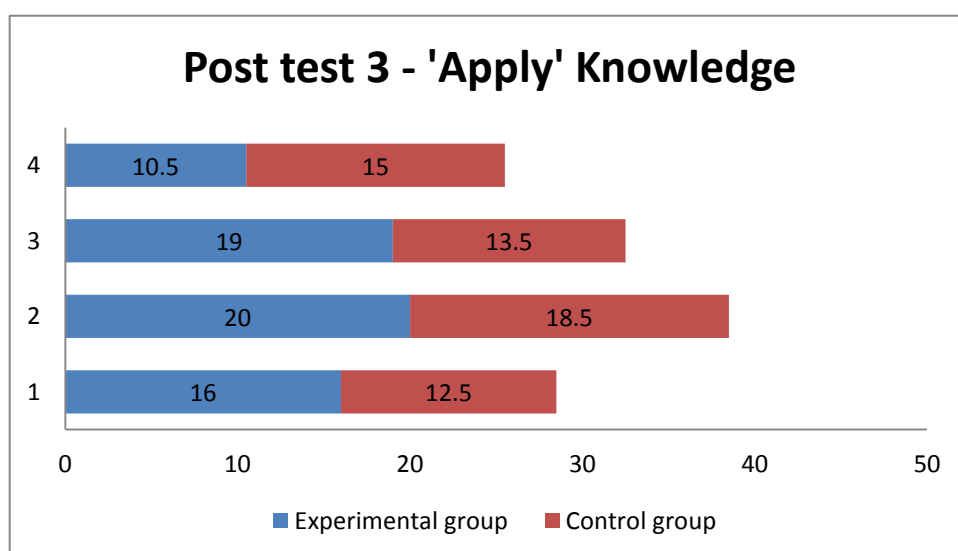


Figure 6-4: To 'apply' knowledge

The mean score of the experimental group was 16.375, while the mean score for the control group was 14.875. This reveals that participants in the experimental group were better in applying the knowledge gained within the previous weeks than the control group.

In addition, participants were asked questions about their use of the app (for experimental group) and paper-based tool (for control group) provided to them between Week Three and Week Four. Tables 6-7 and 6-8 reveal the findings.

Table 6-7: App usage between Week 3 and Week 4

Experimental Group	ACJ	ACC	ACH	ACM
Revised app?	No	No	Yes	No
Number of times	Not applicable	Not applicable	2	Not applicable
For each revision, how long?	Not applicable	Not applicable	5 - 10 mins	Not applicable
Sharing of knowledge acquired?	No	No	No	Not applicable
Mode of knowledge sharing	Not applicable	Not applicable	Not applicable	Not applicable

Table 6-8: Paper-based tool usage between Week 3 and Week 4

Control Group	DCW	DCT	DCV	DCH
Revised document?	No	Yes	No	Yes
Number of times	1	3	Not applicable	1
For each revision, how long?	Less than 5 minutes	10 - 15 mins	Not applicable	5 - 10 mins
Sharing of knowledge acquired?	Yes	Yes	No	No
Mode of knowledge sharing	1. Discussing it	1. Discussing it. 2. Sharing it on social media	Not applicable	Not applicable

The findings therefore reveal that the participants in the experimental group had declined in their use of the app. Participants in the control group were not keen on using the paper-based tool to revise the safe food handling information provided to them and the rate at which they had been using the paper-based tool was constant between the weeks. However, it was noted that participants in the control group were more inclined to share the acquired knowledge. One reason for this could be due to the design of the app which did not include the functionality to share information, as the researcher was concerned with maintaining the privacy of the users of the app, after the completion of the study. As their inclination to share their knowledge was not the main goal of the study, this was not investigated further. Thus, more research would need to be conducted to understand the reason for such behaviour.

On completion of Week 4 tasks, participants were presented with an open-ended questionnaire to provide insights into the learning experience of the participants. This was aimed at understanding their perception of what was learnt within the past 4 weeks, how the app (for experimental group) or paper-based tool (for control group) has helped them learn within the past 4 weeks, if the participants (in the experimental group) would have preferred to use a paper-based tool rather than an app, if the participants (in the control group) would have preferred to use an app rather than a paper-based tool, the participants perceptions of what they would change in their day-to-day kitchen activities and other comments in their learning experience. Tables 6-9 and 6-10 reveal the findings.

Table 6-9: De-briefing experimental group

Experiment-al Group	ACJ	ACC	ACH	ACM
Lessons learnt	1. Correct hand washing technique. 2. Correct hand drying technique. 3. Correct storage locations in the refrigerator to avoid cross contamination. 4. How to tell if meat is cooked and safe to eat. 5. Correct use of chopping board	1. Even if Chicken smells good, if not hot or over 70C, refrigerate within 1 hour for bacteria not to flourish. 2. Hand washing technique. 3. Use of search function within app to access wider range of information.	1. Correct temperature for freezer is -18C. 2. Wash hands for at least 40s. 3. Cooked meat shouldn't be left out for longer than 30 mins before its put in the fridge. 4. Fridge temperature should be about 3C. 5. Burger should have an internal	1. Fridge arrangement. 2. Cooking procedures 3. How to wash hands properly. 4. Always check using app or internet if uncertain. 5. Enjoy cooking and safety of food

	and knife to avoid cross contamination	4. Food storage guidelines for keeping frozen food 5. Cover everything in fridge preferably in sealed containers.	temperature of about 80C	
How app helped in learning	1. The app provided easy access to required information. 2. It also confirmed or rejected previous beliefs. 3. The use of graphics helped to explain	1. Made it easier and quicker to locate information. 2. I found I was more likely to explore app and therefore access more information.	1. Easy to access during reuse. 2. Easy to navigate after first use.	1. Easy to use. 2. Contains useful information
Preference for information and/or knowledge acquisition tool	App and document. 1. The best situation would be to have both as they have their strengths. 2. The app is quick, convenient and easily updated but doc would be easier to skim for information	Document 1. I normally prefer hard copy as it is easy to flick back and forth and also make notes / bookmark useful information. 2. Not totally smartphone literate, often find the text too small to read.	App 1. Like visuals to go with learning. 2. Like to use search terms rather than read through a document	Document 1. I prefer doc as a learning resource as it is a hobby. 2. But app is really easy to use.
Changes to be made in day-to-day kitchen activities	I now know that chicken should be stored in a fridge immediately.	1. Will refrigerate food much more quickly. 2. Paper towel rather than tea towels or wash tea towels more quickly	1. Wash hands more often and for longer. 2. Always have paper towel available. 3. Put cooked food straight in the fridge if not eating straight away. 4. Check freezer temperature regularly	1. Fridge arrangement 2. Remember to wash hands and dry with paper towel 3. Clean kitchen after use
Other comments on experience	None	It was interesting to challenge existing ingrained beliefs on food safety	1. Very enjoyable. 2. Made it easy to learn	I think past 4 weeks were well organised with so much to learn.

Table 6-10: De-briefing control group

Control Group	DCW	DCT	DCV	DCH
Lessons learnt	<ol style="list-style-type: none"> 1. Wash hands for 30 seconds. 2. Do not allow hot foods to be left on bench for longer than 1 hour. 3. Use glass containers to prevent odours passing between foods. 	<ol style="list-style-type: none"> 1. The right temperature of freezer and fridges. 2. If not eating the meat immediately, I should put them into the fridge until serving it. 3. Washing hands until 30seconds. 4. Cutting the meat until smaller pieces before I put them into the freezer. 5. Examining the meat doneness according to the thermometer, not examining it by time or texture colour. 	<ol style="list-style-type: none"> 1. Minimum time to wash hands effectively or safely. 2. Air drying is best to avoid cross contamination. 3. Reheat food to steaming hot before serving leftover. 4. Place food for later consumption into the fridge immediately after cooking. 5. In normal fridges, there is a part that is coldest which is best for storing meat 	<ol style="list-style-type: none"> 1. Hamburgers should be cooked to 75C and not just until brown. 2. Drying your hands with a towel is as bad as not having washed them at all. 3. Raw meat should be kept in the coldest part of the refrigerator, not just the lowest part. 4. They should be frozen in smaller portions, not just in bulk. 5. Food should not be left on the bench for more than one hour.
How paper-based tool helped in learning	<ol style="list-style-type: none"> 1. Was very useful in the first week. 2. It provides an area for discussion at home which made me assess how I do things in my own life 3. It is that discussion that really opened my eyes. 	<ol style="list-style-type: none"> 1. I have acquired the knowledge through the document and practiced what I learnt from it. 	<ol style="list-style-type: none"> 1. I have not used the material. 2. I learnt from my past mistakes doing and reading through the first questionnaire. 	<ol style="list-style-type: none"> 1. Learnt well through reading and writing so a written format works well for me. 2. However, there are certain forms of information that can be presented well in infographic form so pictures in those cases could help with retaining the information.
Preference for information and/or knowledge acquisition tool	<p>App</p> <ol style="list-style-type: none"> 1. But it depends on the app. Important factors are: ease of use. 2. detail of information 	<p>App</p> <ol style="list-style-type: none"> 1. I prefer to use app because I think apps have many advantages. Beautiful showing, convenient to find what I want to read. 2. It is easy to 	<p>App</p> <ol style="list-style-type: none"> 1. Yes, for ease of access. Perhaps, little chunks of information were provided or a food structure where you can reach for particular topics rather 	<p>Both</p> <ol style="list-style-type: none"> 1. I think it would have helped to have both. 2. Getting information in a variety of ways and from a variety of sources is a great way to remember it.

		save and to share with anyone.	than reading through a document to find the relevant section.	
Changes to be made in day-to-day kitchen activities	The length of time of food if left seating on the bench before putting into the fridge.	1. I will pay more attention to food safety. 2. I will share this message with my family members in order to enhance the safety environment in my kitchen. 3. Using the useful utensils in my kitchen.	1. Let dishes air dry. 2. Pay attention to length of hand wash 3. Refrigerate still hot food for later consumption.	1. No more drying with towels. 2. Freeze smaller portions instead of bulk 3. Put extras in the fridge immediately instead of after I eat it.
Other comments on experience	None	I think it is very good.	1. It has been interesting and appreciable.	1. I think an advantage to the app would have been the ability to search the data more easily. 2. Specific facts can be hard to find in written documents

These findings therefore reveal that, regardless of the tool used by the participants, they believe that they had learnt about safe food management. However, it was also noted that participants in the experimental group (app users) were indeed interested in using the paper-based tool while participants in the control group (paper-based tool users) were interested in using the app rather than the paper-based tool.

6.3.5 Post-Experiment Assessment after 6 Weeks

After completing the 4-week experiment, the participants were told they would be given a summary of the results but they were not informed that they would be contacted for further information subsequently. Six weeks after the completion of the experiment, the participants were contacted by phone and asked both closed and open ended questions respectively to investigate their perceived behavioural changes. The closed ended questions were asked to verify the participants' responses to the open-ended questions. The aim of the open-ended questions was to determine if they revised any of the information and/or knowledge acquisition tools, and if so, how many times they revised it. Also, it determined how the participants believe the experiment has helped to improve their behaviour through changes in day-to-day kitchen activities.

Drawn from the initial baseline questionnaire used in Week 1, participants were presented with 10 questions and each participant in both groups was told to identify the most correct answer based on their current knowledge. Each question represents two points. The findings are as shown in Figure 6-5.

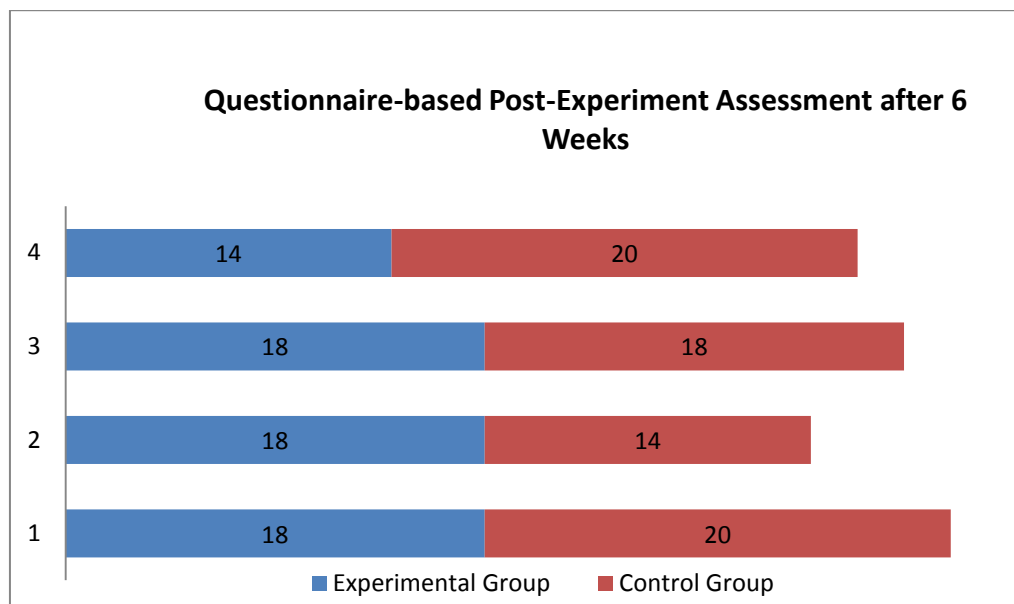


Figure 6-5: Questionnaire-based Post-Experiment Assessment after 6 Weeks

For the open-ended questions, Tables 6-11 and 6-12 reveal the findings.

Table 6-11: Post-experiment Assessment for Experimental Group

Experiment-al Group	ACJ	ACC	ACH	ACM
Revised tool?	No	No	No	Yes - document
Number of times	Not applicable	Not applicable	Not applicable	2
How experiment has helped improve behaviour, through changes in day-to-day kitchen activities	<p>1. Before, I used to leave food on the bench top for long but now I put it straight in the fridge.</p> <p>2. I am now more particular about washing utensils in hot water whereas I used to just do a quick rinse or wipe before.</p>	<p>1. Interesting because on Sunday I cooked something, I normally let it cool on the benchtop but now I am more aware so I put it away immediately, so I don't leave food out in the open.</p> <p>2. I heated food in the microwave and I had to put it back in because it wasn't steaming hot. So, I now make sure things are heated to the right temperature.</p> <p>3. I now make sure meat is at the bottom of the fridge</p>	<p>1. I am a little more aware of washing things rather than just rinsing them under hot water.</p>	<p>1. I changed in the kitchen by buying multiple coloured chopping boards. 2. I now wash hands more after cutting meat and any raw ingredient.</p>

Table 6-12: Post-Experiment Assessment for Control Group

Control Group	DCW	DCT	DCV	DCH
Revised tool?	No	Yes - Document	No	Yes - document
Number of times	Not applicable	Once a week	Not applicable	2
How experiment has helped improve behaviour, through changes in day-to-day kitchen activities	<p>1. Now, I have bought a meat thermometer and I especially focus on chicken in terms of having it hot enough because of the large amount of bacteria.</p> <p>2. I checked the temperature of my fridge after the experiment to ensure it is at the right temperature.</p>	<p>1. What to do before cooking, especially handwashing. I never knew about hand washing for a long time and because I have a child it is important to avoid diseases.</p> <p>2. I now put meat in small pieces before I put them in freezer.</p>	<p>1. I now put warm food straightaway in the fridge. I don't leave them on the bench anymore.</p> <p>2. I let dishes air dry rather than use a towel to dry them.</p>	<p>1. Storing things more separately in the fridge.</p> <p>2. I now put food in small portions in the fridge.</p> <p>3. Using paper towels to dry hands rather than kitchen towels.</p>

Therefore, these results, when compared to the outcome of the de-briefing questionnaire, reveal that all the participants in the experimental group followed through on the changes they intended to make to their day-to-day kitchen activities. However, for participants in the control group, only half of them could fulfil their initial intention of changing some day-to-day food handling practices.

6.4 Assessing Individual Participant during and after the Experiment

As the participants perceived behavioural change was assessed six weeks after the experiment for each individual, this provided a clear picture of the impact of the experiment for each participant. Therefore, the attributes for each participant, and their progress throughout each phase of the pre-experiment, experiment and post-experiment, is discussed in the eight vignettes in Appendix AC. A summary of the vignettes are shown in the following sub-sections.

6.4.1 Summary of Vignette 1: Participant ACJ

The changes in the quantitative results across the initial four-week period and the subsequent six-week period are shown in Figure 6-6. Please see Appendix AC for further details.

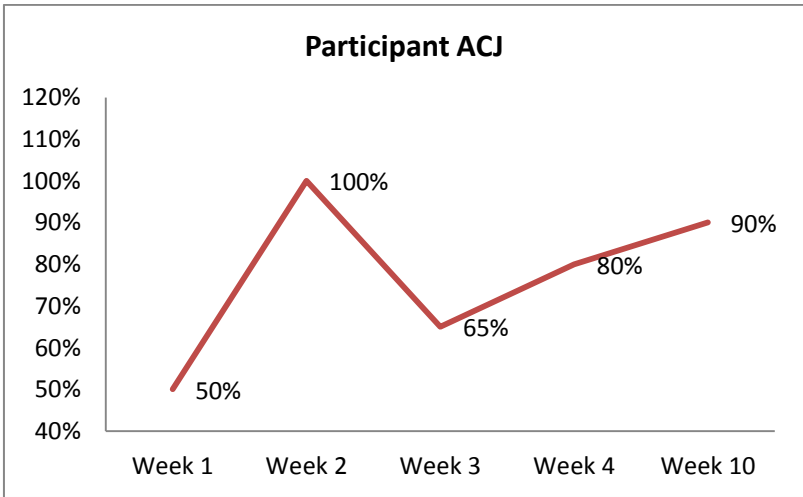


Figure 6-6: Participant ACJ's knowledge optimisation transition

Therefore, this suggests that ACJ's knowledge was successfully optimised as he was able to: demonstrate 'remembrance' to indicate that he did not just receive the information provided by the app but he also acquired the knowledge by assimilating it; demonstrate 'understanding' to indicate that he had retained some of the knowledge; and demonstrate 'application' to indicate that he could apply some of the knowledge

acquired. This implies that the knowledge optimisation that occurred to ACJ is one of the major factors that led to his perceived behavioural change in his day-to-day kitchen activities.

6.4.2 Summary of Vignette 2: Participant ACC

The changes in the quantitative results across the initial four-week period and the subsequent six-week period are shown in Figure 6-7. Please see Appendix AC for further details.

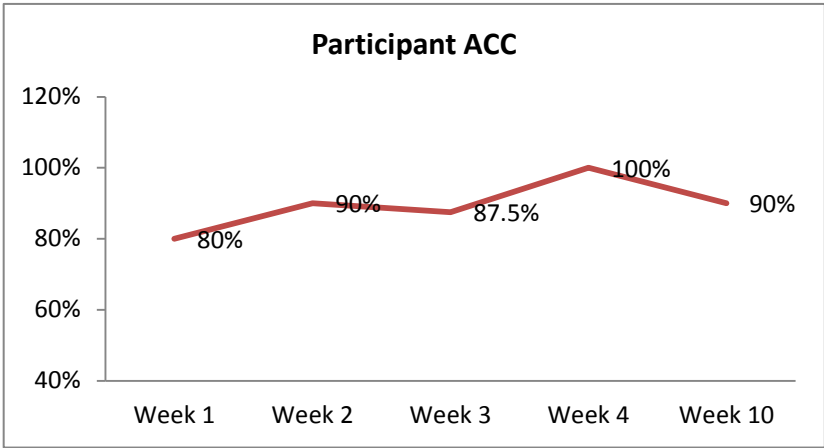


Figure 6-7: Participant ACC's knowledge optimisation transition

Therefore, this suggests that ACC’s knowledge was optimised as she was able to: demonstrate ‘remembrance’ to indicate that she did not just receive the information provided by the app but she also acquired the knowledge by assimilating it; demonstrate ‘understanding’ to indicate that she had retained some of the knowledge; and demonstrate ‘application’ to indicate that she could apply some of the knowledge acquired. This implies that the knowledge optimisation that occurred to ACC is one of the major factors that led to her perceived behavioural change in her day-to-day kitchen activities.

6.4.3 Summary of Vignette 3: Participant ACH

The changes in the quantitative results across the initial four-week period and the subsequent six-week period are shown in Figure 6-8. Please see Appendix AC for further details.

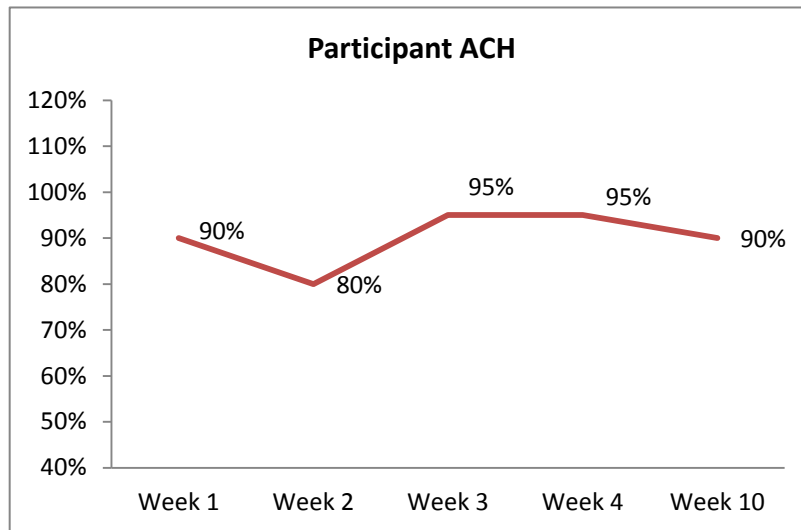


Figure 6-8: Participant ACH's knowledge optimisation transition

Therefore, this suggests that ACH's knowledge was not necessarily optimised as she was not able to demonstrate 'remembrance' to indicate that she did not just receive the information provided by the app but she also acquired the knowledge by assimilating it. However, she was able to demonstrate sufficient 'understanding' to indicate that she had retained some knowledge; and demonstrate 'application' to indicate that she could apply most of the knowledge acquired. As minor changes occurred to her knowledge levels, this however implies that any knowledge optimisation that occurred to ACH may not necessarily be the factor that led to her perceived behavioural change in her day-to-day kitchen activities.

6.4.4 Summary of Vignette 4: Participant ACM

The changes in the quantitative results across the initial four-week period and the subsequent six-week period are shown in Figure 6-9. Please see Appendix AC for further details.

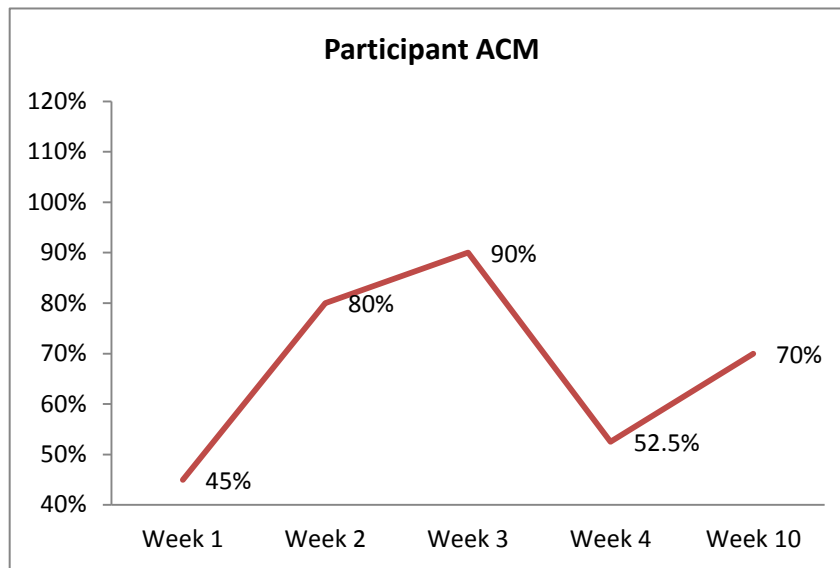


Figure 6-9: Participant ACM's knowledge optimisation transition

Therefore, this suggests that ACM's knowledge was successfully optimised, despite his tendency to be reliant on any of the information and/or knowledge acquisition tools which was revealed through the huge decline in Week 4 due to the deviation from the use of the app in the preceding week. Nonetheless, he was able to: demonstrate 'remembrance' to indicate that he did not just receive the information provided by the app but he also acquired the knowledge by assimilating it; demonstrate 'understanding' to indicate that he had retained some of the knowledge; and demonstrate 'application' to indicate that he could apply some of the knowledge acquired. This implies that the knowledge optimisation that occurred to ACM is one of the major factors that led to his perceived behavioural change in his day-to-day kitchen activities.

6.4.5 Summary of Vignette 5: Participant DCW

The changes in the quantitative results across the initial four-week period and the subsequent six-week period are shown in Figure 6-10. Please see Appendix AC for further details.

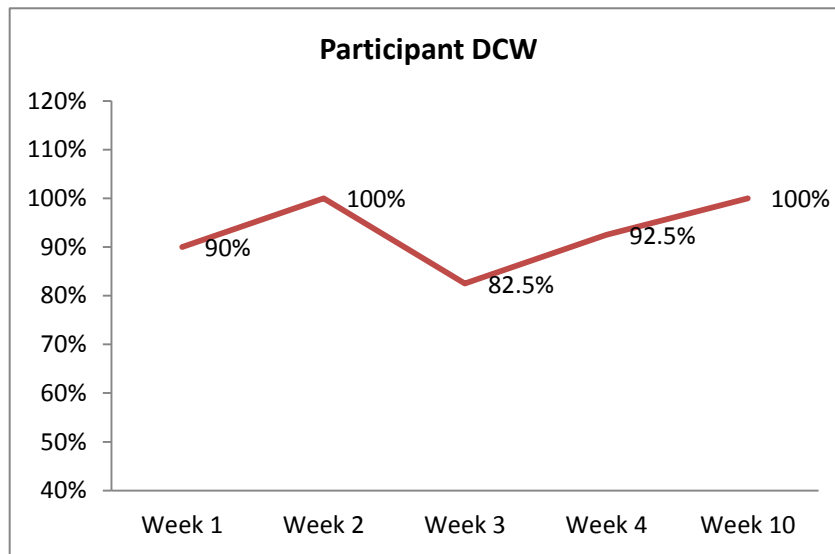


Figure 6-10: Participant DCW's knowledge optimisation transition

Therefore, this suggests that DCW's knowledge was only slightly optimised as he was able to: demonstrate 'remembrance' to indicate that he did not just receive the information provided by the document but he also acquired the knowledge by assimilating it; demonstrate some 'understanding' to indicate that he had retained some of the knowledge; and demonstrate 'application' to indicate that he could apply some of the knowledge acquired. This implies that the knowledge optimisation that occurred to DCW is one of the major factors that led to his perceived behavioural change in his day-to-day kitchen activities.

6.4.6 Summary of Vignette 6: Participant DCT

The changes in the quantitative results across the initial four-week period and the subsequent six-week period are shown in Figure 6-11. Please see Appendix AC for further details.

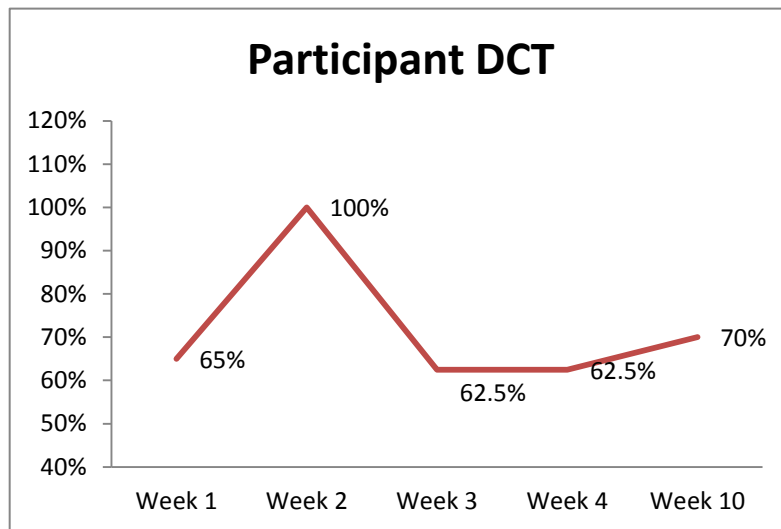


Figure 6-11: Participant DCT's knowledge optimisation transition

Therefore, this suggests that DCT's knowledge was not necessarily optimised as she was able to: demonstrate 'remembrance' to indicate that she did not just receive the information provided by the document but she also acquired the knowledge by assimilating it; but not able to demonstrate sufficient 'understanding' which indicates that she had not necessarily retained the knowledge; and she was also not able to demonstrate 'application' which indicates that she could not really apply the knowledge acquired. This implies that DCT's knowledge was not necessarily optimised though she was consistent with the revision of the document on a weekly basis. Perhaps, it was the frequent revision of the document that led to her perceived behavioural change in her day-to-day kitchen activities as she was able to eventually improve in her safe food management knowledge after the 10-week period.

6.4.7 Summary of Vignette 7: Participant DCV

The changes in the quantitative results across the initial four-week period and the subsequent six-week period are shown in Figure 6-12. Please see Appendix AC for further details.

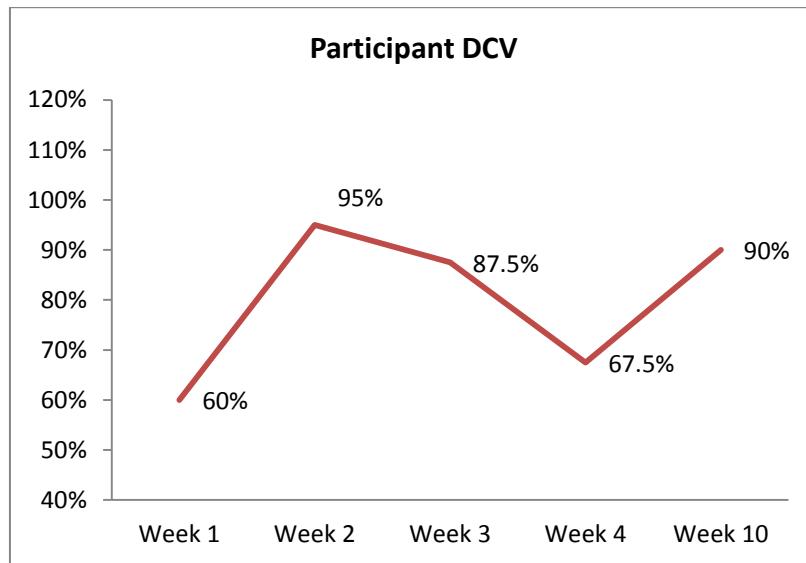


Figure 6-12: Participant DCV's knowledge optimisation transition

Therefore, this suggests that DCV's knowledge was optimised as she was able to: demonstrate 'remembrance' to indicate that she did not just receive the information provided by the paper-based tool on the first day of the experiment but she also acquired the knowledge by assimilating it; demonstrate 'understanding' to indicate that she had retained some of the knowledge; and demonstrate 'application' to indicate that she could apply some of the knowledge acquired. This implies that the knowledge optimisation that occurred to DCV is one of the major factors that led to her perceived behavioural change in her day-to-day kitchen activities.

6.4.8 Summary of Vignette 8: Participant DCH

The changes in the quantitative results across the initial four-week period and the subsequent six-week period are shown in Figure 6-13.

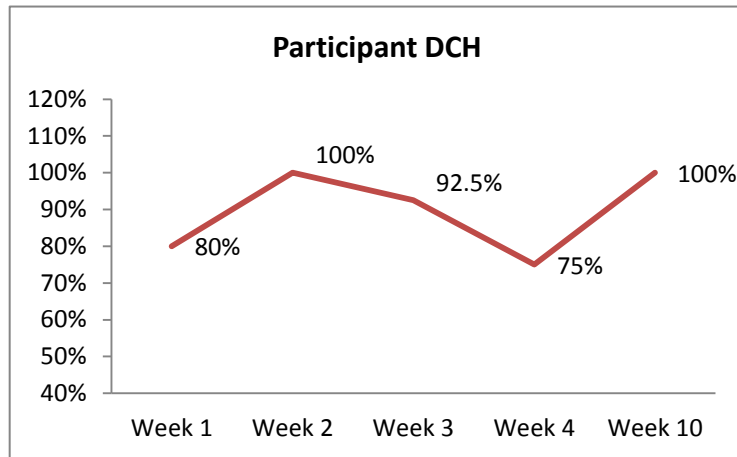


Figure 6-13: Participant DCH's knowledge optimisation transition

Therefore, this suggests that DCH's knowledge was successfully optimised as he was able to: demonstrate 'remembrance' to indicate that he did not just receive the information provided by the paper-based tool but he also acquired the knowledge by assimilating it; demonstrate some 'understanding' to indicate that he had retained some of the knowledge; and demonstrate 'application' to indicate that he could apply some of the knowledge acquired. This implies that the knowledge optimisation that occurred to DCH, which was facilitated by his consistent revision of the paper-based tool, is one of the major factors that led to his perceived behavioural change in his day-to-day kitchen activities.

In summary, these reveal that even when participants have the same treatment, the outcomes for each individual is not necessarily the same as the different skills and attributes of each person plays an important role in shaping how the app or paper-based tool would influence them.

6.5 Demonstrating Remembrance to Emphasise Knowledge Acquisition

Knowledge acquisition in this study is described as knowledge inflow (Mom et al., 2007) where the recipient – the consumer – acquires safe food management knowledge from the donor – government authorities, best practice guidelines, research studies. To demonstrate that the information provided to the participants through the app or paper-based tool has been assimilated and embodied as knowledge, it is the level of remembrance that occurred between Week 1 and 2 that is assessed in the experiment as

shown in Figure 6-14. In Week 1, the pre-existing knowledge level of the participants showed that the experimental group had a lower level at 66.3% when compared with the control group which had a knowledge level of 73.8%. Although both groups learnt by reading through the tool made available to them, listening to lessons learnt by their group members, and verbalising lessons learnt as individuals; they were also asked to revise the learning material during the course of the week.

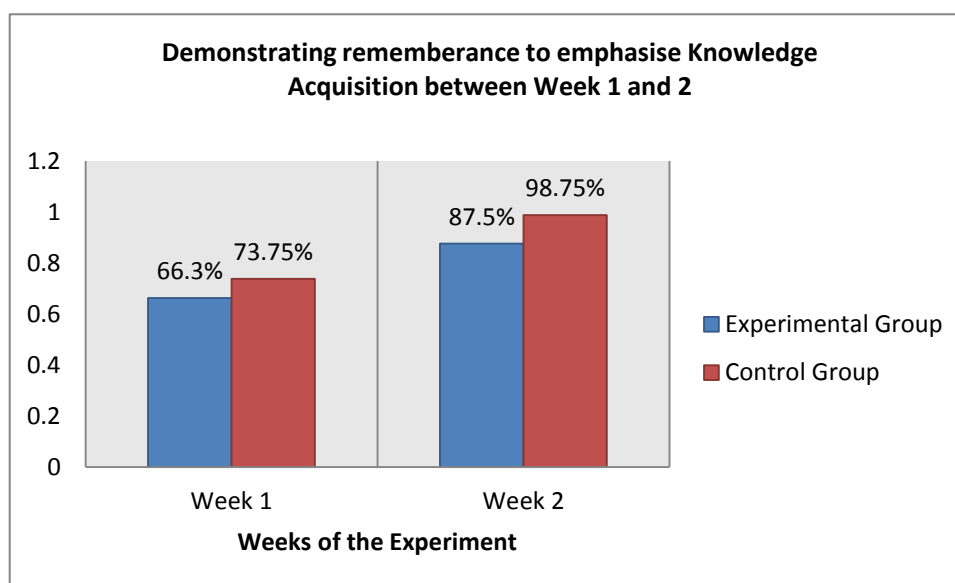


Figure 6-14: Demonstrating remembrance to emphasise Knowledge Acquisition between Week 1 and 2

In Week 2, when the participants were tested to see if they could remember what was learnt within the previous week, the control group again performed better at 98.8% when compared with the experimental group with 87.5%. Perhaps this can be explained by the cognitive load theory which is concerned with the learning of complex cognitive tasks that occur when individuals are burdened with information elements and their interactions that need to be processed concurrently before knowledge acquisition can occur (Paas and Van Gog, 2006). Based on this theory, and the theory of multimedia learning, the three types of cognitive processing that can contribute to this load are the intrinsic, extraneous or germane cognitive processing (DeLeeuw and Mayer, 2008). The intrinsic cognitive load occurs when tasks with a high number of interactive elements place high demands on working memory (Paas and Van Gog, 2006). Extraneous cognitive load occurs due to the format and manner of information presentation and the requirements of the instructional activities on the working memory (Brunken et al.,

2003). The germane cognitive load is generated by the efforts of the learner to process and comprehend the learning material (Brunken et al., 2003).

As the SFM app presented to the experimental group was newly developed, it contained a higher level of extraneous cognitive load when compared to the paper-based tool presented to the control group. Participants in the experimental group grappled with the first use of an app that was not familiar to them, as such; this placed a level of demand on the working memory as there is a level of cognitive load associated with learning and using a new app for the very first time (Patel, 2016). Thus, the process of using the new app for the first time contained a higher level of extraneous cognitive load in the experimental group when compared to using a paper-based tool (essentially a document) for the first time in the control group. Over the years, significant effort has been placed on the reduction of extraneous cognitive load and the optimisation of germane cognitive load (Ayres and Paas, 2012). In this study, efforts were also made to achieve the same goal, by applying the principle of modality effect (Brunken et al., 2003) which will be discussed in subsequent sub-sections.

6.6 Demonstrating Understanding to Emphasise Knowledge Retention

According to Caroline Martins and Meyer (2012) knowledge retention is the ‘maintenance of knowledge’ that exists in the minds of people and the ‘maintenance of knowing’ that is referred to as experiential action manifesting in behaviour. In addition, it has been argued that the manifestation of knowledge through certain behaviour during cognitive and knowledge acquisition processes could enhance knowledge retention (Martins and Martins, 2011).

As meaningful learning occurs on a continuum (Novak, 2002, Ausubel, 2012), it is imperative to ensure there is a clear difference between rote learning and meaningful learning by demonstrating that participants indeed understand and can retain the knowledge acquired. Drawing on Grunert et al. (2010), understanding is defined as the ability of the participant to interpret the required information correctly by remembering it and describing it in their own words. To ensure this occurred, understanding was demonstrated by giving the participants an open-ended scenario-based test where they could use the information presented in previous weeks in new ways that go beyond what was presented to them. This approach is also known as the transfer test aimed at measuring understanding as defined and evaluated by Mayer and Chandler (2001).

In this study, the process of demonstrating understanding to emphasise knowledge retention involves the activities that occurred between Week 2 and 3 as shown in Figure 6-15.

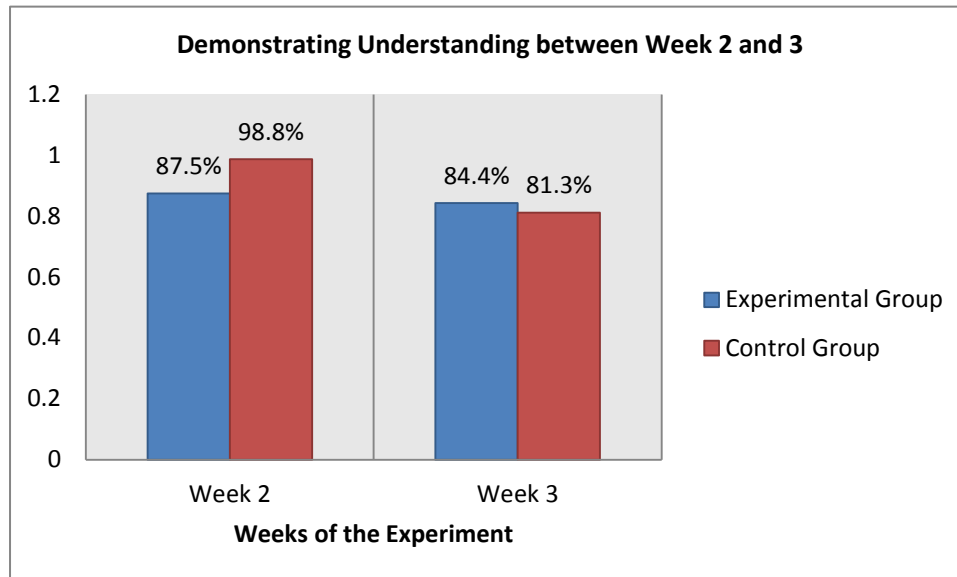


Figure 6-15: Demonstrating Understanding between Week 2 and 3

In Week 2, when the participants were tested to see if they could remember what was learnt within the previous week, the control group performed better at 98.8% when compared to the experimental group with 87.5%. As discussed in the preceding subsection, this was likely due to the extraneous cognitive load which placed a higher level of demand on the working memory of the experimental group when compared to the control group. However, in Week 3, when the participants were tested to see if they indeed understood what was learnt within the previous weeks, the experimental group performed better at 84.4% when compared to the control group with 81.3%. This suggests that participants in the experimental group were able to demonstrate knowledge retention through a better understanding of the app when compared to the control group.

This could be explained by the principle of modality effect that was applied to the safe food management app presented to participants in the experimental group. According to Mayer and Chandler (2001), this principle states that “knowledge acquisition is better facilitated by materials presented in a format that simultaneously uses the auditory and the visual sensory modality than by a format that uses only the visual modality” (Brunken et al., 2003). As earlier stated, the experimental group utilised an app which

contained text, pictures and videos as information modalities while the control group utilised a paper-based resource containing only text. Findings in Week 3 revealed that the higher level of information acquisition that the control group portrayed between Week 1 and 2 was not only artificial but was also temporary. Thus, the control group demonstrated a higher '*surface knowledge*' which does not necessarily translate into a corresponding level of understanding. Perhaps an over-simplified example that illustrates the preceding argument is this: a learner in Week 1 was taught that $2+4=6$, in Week 2 he was given a task to solve $4+2$ and he knows the answer is 6 as he has recently seen a combination of those two numbers though in a reverse order. He just does not understand how the principle of addition works. In Week 3, he was given a task to solve 7 apples + 3 apples and he provided a wrong answer. As a result, it is believed that such '*surface knowledge*', which occurred between Week 1 and 2 for the control group is closer to the rote learning end of a meaningful learning spectrum.

On the other hand, it can be argued that the experimental group was able to portray a better understanding of the app, as the different information modalities contributed towards the reduction of the extraneous cognitive load and the optimisation of the germane cognitive load. This would not have occurred if the app was text-based only. In addition, the initial extraneous cognitive load associated with learning and using a new app (Patel, 2016) was no longer applicable. Thus, due to the multimodal nature of the app and the familiarity with the app for the experimental group, there was a lower amount of load in the visual working memory as auditory and visual information were distributed and processed in their respective cognitive sub-systems. These findings correspond with studies such as Harskamp et al. (2007), Baggett (1979) in the educational psychology domain and Barkhordar et al. (2000), Murphy et al. (2000) in the health domain.

6.7 Demonstrating Knowledge Application

Knowledge application was demonstrated by giving the participants open-ended questions based on a rich physical environment which incorporated a safe food handling situation in a kitchen. This approach, aimed at applying knowledge in a rich physical environment such as an indoor environment as it has been used in other studies such as Sung et al. (2010), Chiou et al. (2010). In this study, the process of demonstrating

knowledge application involves the activities that occurred between Week 3 and 4 as shown in Figure 6-16.

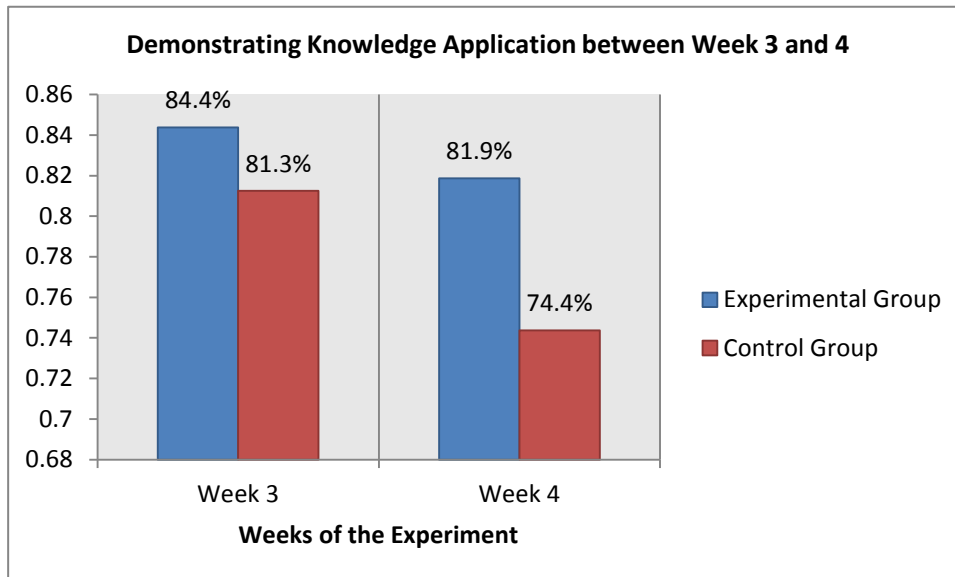


Figure 6-16: Demonstrating Knowledge Application between Week 3 and 4

In Week 3, when the participants were tested to see if they indeed understood what was learnt within the previous weeks, the experimental group performed better at 84.4% when compared to the control group with 81.3%. As stated in the preceding sub-section, this suggests that participants in the experimental group were able to apply acquired knowledge through a better understanding of the app when compared to the control group. In Week 4, when the participants were tested to see if they could apply the knowledge gained within the previous weeks, the experimental group performed much better at 81.9% when compared to the control group with 74.4%.

Again, this result could be explained by the principle of modality effect (Mayer and Moreno, 2003) as it has been argued that the different information modalities did not only contribute towards the reduction of the extraneous cognitive load but the optimisation of the germane cognitive load. Thus, the multimodal nature of the app for the experimental group facilitated a lower amount of load in the visual working memory as auditory and visual information were distributed and processed in their respective cognitive sub-systems (DeLeeuw and Mayer, 2008). Therefore, it is believed that the

germane cognitive load (Paas and Van Gog, 2006) was indeed optimised as it facilitated a better retention of knowledge within the specified time.

6.8 Usage of the App or Paper-based Tool during the 4-Week Experiment

The developed app and the document were the learning materials used for the acquisition of information and knowledge, during the course of the experiment. As discussed in sections 3 and 5, the participants in the experimental group were given access to the app only while the participants in the control group had access to the paper-based tool only. Consequently, the learning material was in the possession of each of the participants for four weeks. However, the learning materials were used differently by the two groups between one week and the other, as shown in Figure 6-17 below.

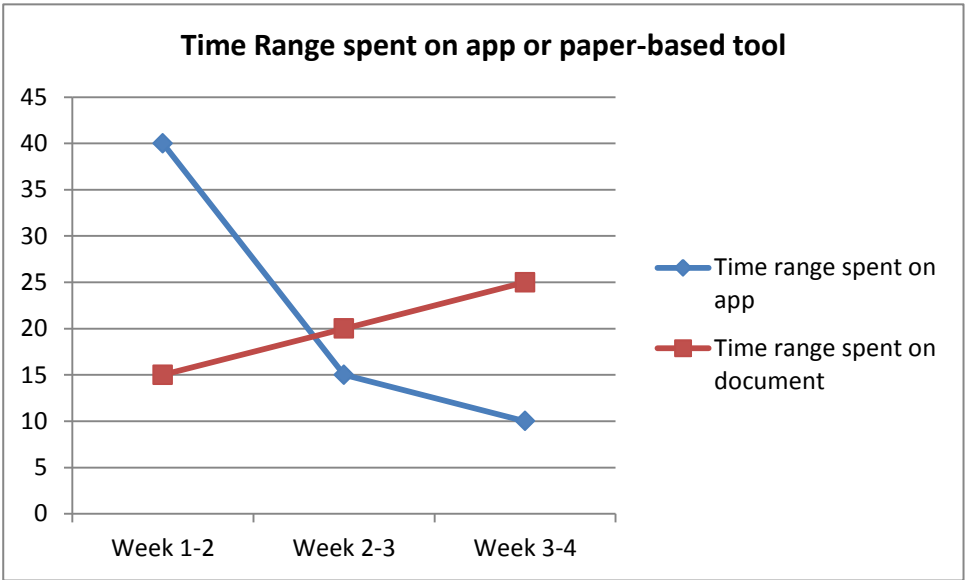


Figure 6-17: Time spent on the knowledge acquisition tool

As revealed by the results, the time range spent on the app by the experimental group declined between the initial and final week of the experiment while the time range spent on the paper-based tool increased within the same period. Despite this result, the experimental group indeed spent more time (65 minutes) with the app compared to the

control group (60 minutes) when considering the aggregate value of the time range across the weeks.

It is interesting to note that despite the increasing use of the paper-based tool within the control group, the level of knowledge retention across the period of the experiment declined, whereas it was the exact opposite for the experimental group. This is interesting because the finding suggests that the amount of time spent using an information/knowledge acquisition tool does not necessarily correspond to the level of knowledge retained. As earlier argued in section 6.7, this is due to the multimodal nature of the app for the experimental group. This facilitated a lower amount of load in the visual working memory as auditory and visual information were distributed and processed in their respective cognitive sub-systems (DeLeeuw and Mayer, 2008). Nonetheless, the decline in the use of the app over the period of the experiment is in line with the evidence in the literature (Racherla et al., 2012) about the problem of ‘app stickiness’ as users tend to drop-off after using the app for a period of time. According to Elina Jaakkola et al. (2015), organisations tend to prefer the stickiness of an app due to the value it provides, as it helps them gain deep insights into the use and experiences of consumers but app stickiness was deemed irrelevant in the context of this study. In fact, the model of development of the app, focused on the elimination of technology dependency for the users, due to safety reasons in a kitchen environment. The intention was for the users to learn through the app and only re-visit it for quick knowledge updates very occasionally. More on how the affordances of the app allows for such quick but infrequent re-visits is discussed in section 7.2.3.

Therefore, this suggests that though the participants in the experimental group were less dependent on the app, they were able to retain the knowledge more. On the other hand, the participants in the control group relied more on the learning material, yet could not retain as much knowledge as those of the experimental group.

6.9 Phase Three – Initial Findings

The focus of phase three was to investigate how the use of the app influences consumer knowledge acquisition, knowledge retention and perceived behavioural change. This was done by conducting a 4-week field experiment to collect data, through face-to-face closed and open-ended questionnaires on safe food handling knowledge from

participants. The initial findings of Phase Three of the research are classified into four key points.

First, across the four-week period of the experiment, the research activities have revealed the impact of the modality effect on the level of knowledge acquisition, knowledge retention and knowledge application of the participants, thus demonstrating that the knowledge of the participants has been optimised. This argument can be substantiated from two perspectives;

Perspective One: In this study, the participants given the safe food management app fit the following characterisation of adult learners (De Vito, 2010);

- They are typically aged 24 years or older
- They are not financially dependent on parents or guardians
- Their main responsibilities are outside schooling
- Their principal identities have evolved beyond the role of full-time student.

This differentiates the participants used in the experimental group from traditional students thus suggesting the applicability of adult learning (andragogy) models rather than pedagogical models. As andragogy is the art and science of teaching adults based on the six assumptions of self-directedness, need to know, use of experience in learning, readiness to learn, orientation to learning, and internal motivation (Knowles et al., 2014); it is a framework that is appropriate for the types of participants used within the experimental group for this study. An example of how one of those participants demonstrated the six key principles of adult learning emerges from section 6.4.4 (participant ACM), where the research participant fully used the multiple modality app throughout the 4-week period of the experiment. As described by De Vito (2010), each of these principles will be discussed in relation to participant ACM.

1. *The learner's need to know:* The learning process must satisfy their need to know, in that they must know how the learning will be conducted, what will be learnt and why the learning is important (Knowles et al., 1998). For participant ACM, it is believed that he was satisfied in these dimensions as he was given a detailed information sheet that answers those questions before the commencement of the experiment (See Appendix Q).

2. *Self-concept of the learner*: This is concerned with the autonomy and self-directedness of the learner. Autonomy involves taking control of the goals of one's learning while self-directedness involves self-teaching in a certain subject area (Knowles et al., 1998). For this participant, autonomy was satisfied by providing him with the app to take home, during the 4-week period, such that he could learn at his own pace. Self-directedness was fulfilled by the participant as findings suggest that he indeed studied the app consistently between the weeks of the experiment.
3. *Prior experience of the learner*: This can create a broader range of individual differences, provide a resource for learning and can create a bias which may facilitate or inhibit new learning (Knowles et al., 1998, De Vito, 2010). Whilst participant ACM did not share in-depth details of his prior experience, the findings suggest that he believed the safe food management practices in his kitchen, before the experiment, were not optimal as he needed to make changes to three areas.

“fridge arrangement; remembering to wash hands and dry with paper towel; and the cleaning of kitchen after use” - ACM

This prior experience in his own home made him think that there is a need for him to make changes, thus facilitating new learning.

4. *Readiness to learn*: This occurs when a life situation creates a need to know (Knowles et al., 1998, De Vito, 2010). As earlier discussed, the findings reveal that ACM was consistent with the use of the app to gain more knowledge regarding safe food management. Except during one of the 4 experiment weeks, the participant was consistent in the use of the app, which portrays his readiness to learn.
5. *Orientation to learning*: This principle is concerned with the role of current experiences in shaping the need to learn as adults learn best when information is presented in real-life contexts (De Vito, 2010). In this study, the context of the experiment portrayed a real-life situation (safe food management), problem-based scenarios (Week 3) and actual kitchen-based scenarios (Week 4); thus offering a problem-solving orientation rather than a subject-centred orientation. It is therefore argued that this problem-solving orientation made participant ACM

relate to the learning process as he described himself as someone who purchases, cooks and eats meat frequently; at least once a week.

6. *Motivation to learn:* In relation to this principle, it is believed that adults are motivated towards learning that helps them address issues that are personal to them (De Vito, 2010). For participant ACM, he emanated his motivation by striving to be knowledgeable so he could share the knowledge acquired to demonstrate superiority.

“...I shared knowledge by discussing it and correcting someone’s food handling practice”. - ACM

Whilst ACM had the least level of knowledge retention by the end of the experiment, there is evidence to support the effectiveness of the app as the participant demonstrated a significant knowledge increase when the app was used, no increase in knowledge when no tool was used and a slight increase in knowledge when a paper-based tool was used.

Perspective Two: Again, the results of this study reveal that participants within the experimental group were more able to demonstrate knowledge retention over the 4-week period than those of the control group. For the experimental group, there was an increased level of knowledge between week 1 and 4 when comparing the aggregate knowledge scores. However, for the control group, there was a decline in the level of information and/or knowledge retained over time as there was no increase in the overall level of knowledge when comparing the aggregate knowledge scores. Thus, it is believed that the modality through which the information was presented to the participants, made a difference in this context.

A notable example from one of the participants in the experimental group relates to the level of retention that occurred to him (Participant ACM) by consistently using the app. It was however noted that whenever he failed to use the app, he was unable to demonstrate any increase in knowledge whatsoever (see Figure 6-9). This reveals that he has the tendency to rely on the app to reinforce his knowledge retention.

On the other hand, it was also noted that the paper-based tool was not necessarily helpful for knowledge retention for participant DCT. She relied on the tool even more consistently than participant ACM by reading through the document every week throughout the course of the 4-week experiment. Yet, she was unable to improve in her

knowledge level as she declined from week 1 to week 4. Despite the fact that both participants discussed what they had learnt with friends and family, thus facilitating informal interactions, the findings reveal that the reinforcement and retention of knowledge over time was not necessarily due to the informal interactions. This indicates that the multimodal nature of the smartphone app played a role in the retention of the knowledge of the participants over time. Therefore, based on both perspectives, this research supports the findings of Mayer (2014) that multiple modalities are more effective in delivering information to influence knowledge retention.

Second, the findings reveal that the SFM app (experimental group) required more time to be spent to achieve knowledge acquisition which resulted in retaining the knowledge for a longer period of time than the paper-based information delivery technique (control group). As earlier defined, knowledge optimisation, in this study, involves ensuring that knowledge acquisition occurs, the knowledge has been retained and the knowledge can be applied. Figure 6-18 shows the transition of knowledge-related activities for the experimental group across the spectrum portrayed by this investigation.

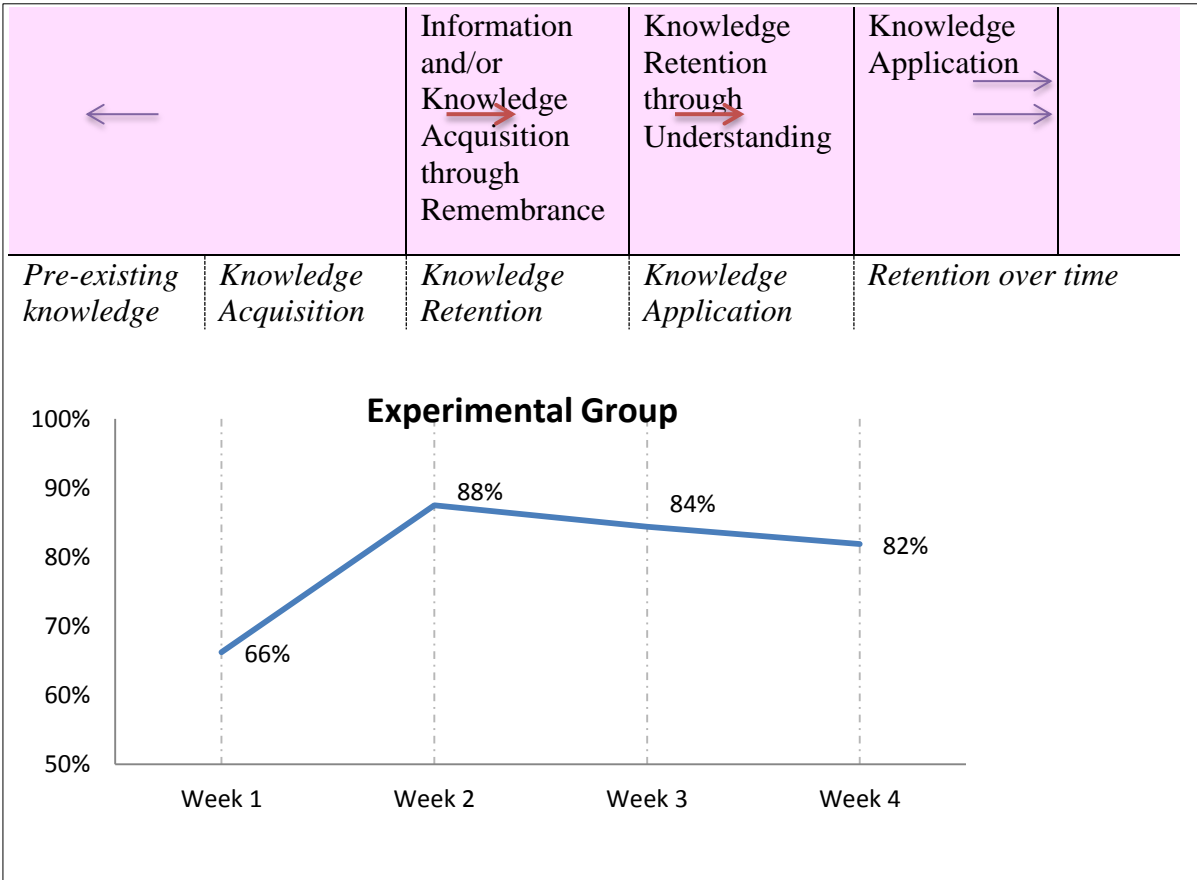


Figure 6-18: Normal Transition of the Experimental Group across the Knowledge Optimisation Spectrum

Whilst there was a steady decline in the level of information and/or knowledge retained by the participants over time, there was an increased level of knowledge from 66% to 82% when comparing the pre-existing knowledge (in Week 1) with the knowledge level at the fourth week mark. However, the findings for the control group are quite different. Figure 6-19 shows the transition of information and/or knowledge-related activities for the control group across the spectrum portrayed by this investigation.

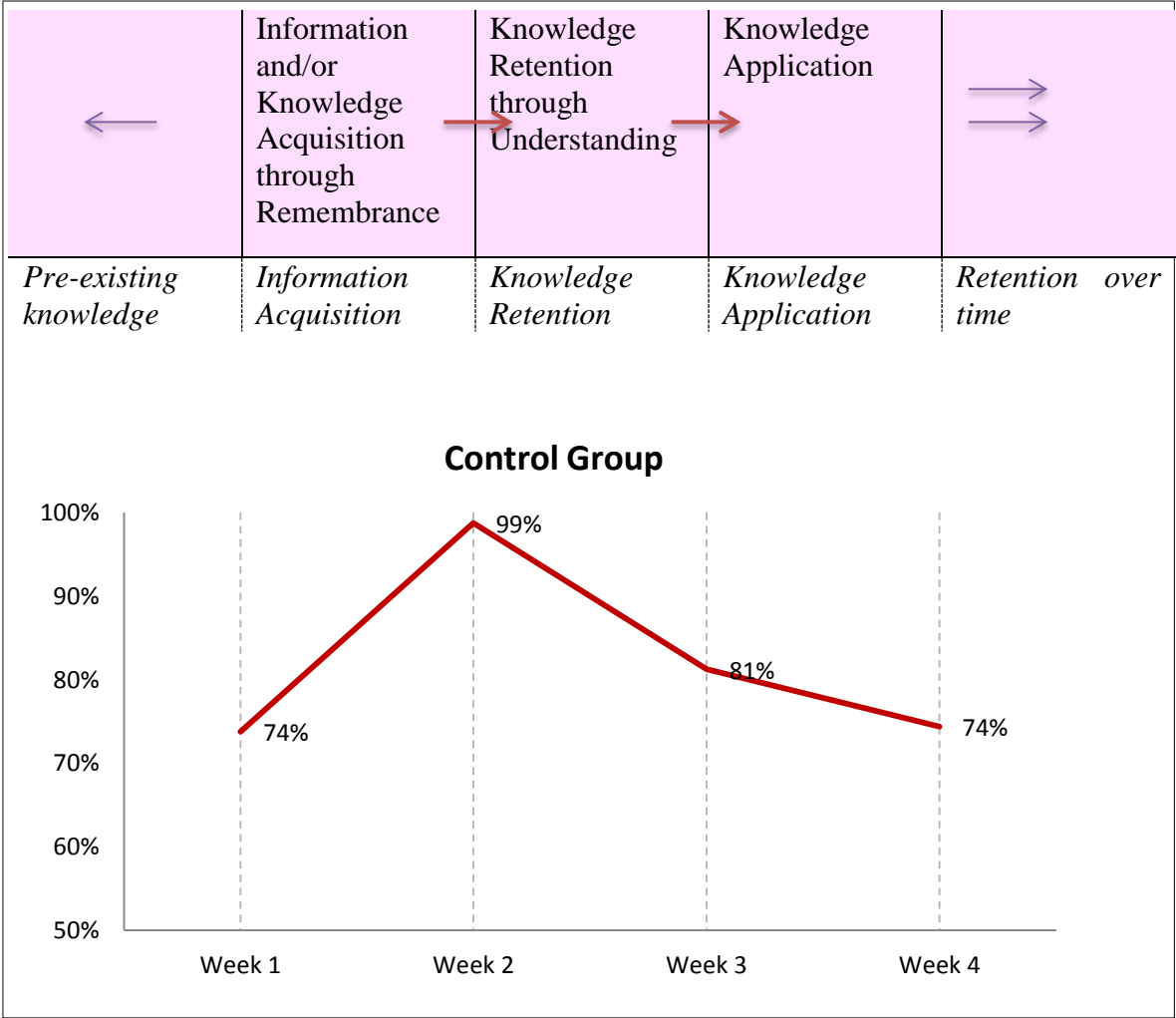


Figure 6-19: Normal Transition of the Control Group across the Knowledge Optimisation Spectrum

For the control group, there was a decline in the level of knowledge retained over time as shown by the difference in the knowledge level in Week 1 (pre-existing knowledge) and Week 4. This reveals that the ‘*surface knowledge*’ gained in Week 1, which resulted in the artificial increase in knowledge as shown in Week 2 was indeed very temporary. In fact, the findings reveal that the control group had experienced a complete reversal of the knowledge optimisation spectrum. This is shown by the mirror image of the normal transition of the control group across the knowledge optimisation spectrum as portrayed by Figure 6-20.

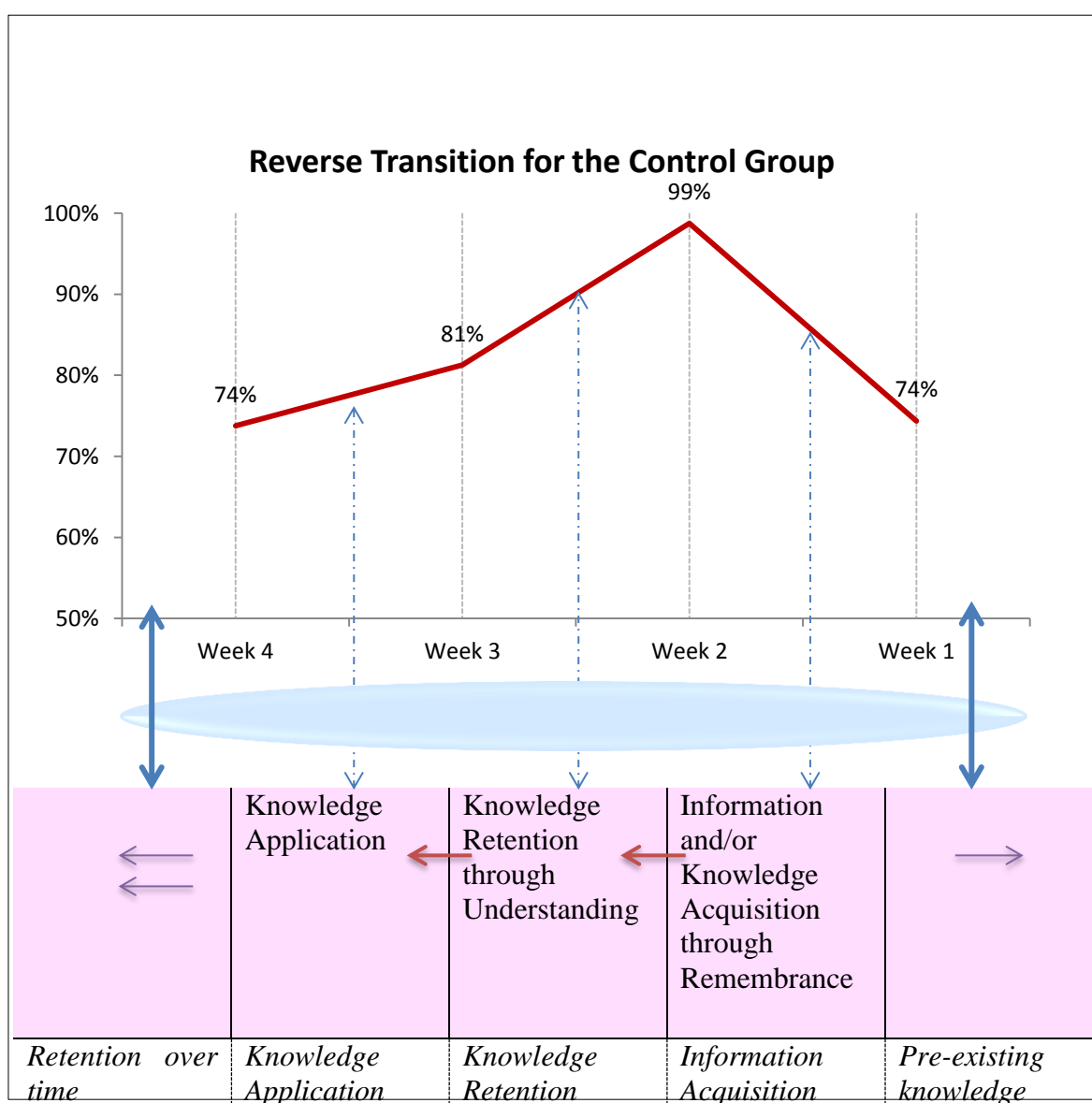


Figure 6-20: Reverse Transition of the Control Group across the Knowledge Optimisation Spectrum

Based on Figure 6-20, from Week 4 onwards, participants in the control group, could no longer remember what was learnt during the course of the experiment, thus portraying a zero percent increase in knowledge retention. Between Week 3 and 4, the participants could remember some of the information and/or knowledge gained but could not apply it significantly. Between Week 2 and 3, the participants could demonstrate a significant level of understanding, thus suggesting that they could apply the acquired knowledge to situations presented to them. Between Week 1 and 2, the participants could generate some level of '*surface knowledge*' which could not be applied over time. Before Week 1 of the experiment, the participants only had some pre-existing knowledge which was an average of 74%. At the end of the 4-week experiment, they had indeed reverted to their pre-existing level of knowledge at 74%.

Third, whilst smartphone apps induce some level of cognitive load in adoption (between Week 1 and Week 2), there is evidence to suggest that the affordance of quick but infrequent app reuse facilitates knowledge retention. With reference to section 6.8, participants in the experimental group spent a shorter period of time during app reuse between Weeks 2 and 4, which resulted in a higher level of knowledge retained. However, participants in the control group spent a longer period of time using the paper-based tool, yet the level of knowledge retained declined between Weeks 2 and 4. Therefore, cues that draw attention to app reuse, for quick but infrequent revisitation, could be beneficial for knowledge reinforcement.

Fourth, food management behaviour is intimately linked to the individual, habit, knowledge and context of use. Though age and gender have been identified as important factors that have the potential to influence technology and food preparation skills, other behavioural factors appear to have been identified which can be demonstrated by three perspectives as follows;

Perspective one - perceived personal relevance: This emerges from section 6.4.7 (participant DCV), where the research participant did not use the paper-based tool throughout the 4-week period of the experiment, except on the initial day of the experiment. Whilst she stated that she would have preferred to use the app, the findings reveal that she did not use the app even when she was given access to both tools (app and paper-based tool), during the subsequent 6-week period. Thus, this indicates that the participant *did not necessarily believe that the information in the paper-based tool was*

objectively personally relevant to her; as having access to useful information does not mean it would be used.

Perspective two - individual differences moderating adult learning: This emerges from section 6.4.6 (participant DCT), where the research participant fully used the paper-based tool throughout the 4-week period of the experiment and the 6-week period after the experiment. Yet, the participant could achieve little or no value from the use of the paper-based tool as better understanding and knowledge application in safe food management could not be successfully demonstrated during the initial 4-week period. However, at the end of the subsequent 6-week period, she was able to remember some of the information and knowledge acquired while stating her perceived behavioural changes. Thus, this reveals that the participant required a much longer period of time to demonstrate that her knowledge had been optimised.

These findings suggest that despite the participant's demonstration of the six key principles of adult learning, even when the experiment was not a formal enrolment into an educational program, participant DCT emanated individual differences that influenced the poor rate at which her knowledge was optimised. This conforms with the argument provided by De Vito (2010) that individual differences is one of the factors that affect adult learning. To shed more light on this, each of these principles will now be discussed and will be related to participant DCT.

- a. *The learner's need to know:* For participant DCT, it is believed that she was satisfied in these dimensions as she was given a detailed information sheet that answers those questions before the commencement of the experiment (See Appendix Q).
- b. *Self-concept of the learner:* For this participant, autonomy was satisfied by providing her with the paper-based tool to take home, during the 4-week period, such that she could learn at her own pace. Self-directedness was fulfilled by the participant as findings suggest that she indeed studied the paper-based tool consistently during each week of the experiment.
- c. *Prior experience of the learner:* Whilst participant DCT did not share in-depth details of her prior experience, the findings suggest that she believed the safety environment in her kitchen, before the experiment, was not optimal.

“sharing what was learnt with family members in order to enhance the safety environment in my kitchen” - DCT

This prior experience in her own home made her think that there is a need for her to *“pay more attention to food safety”*, thus facilitating new learning.

- d. *Readiness to learn*: As earlier discussed, the findings reveal that DCT was consistent with the use of the paper-based tool to gain more knowledge regarding safe food management. In fact, of all the other participants, she was the most consistent in its use, which portrays her readiness to learn.
- e. *Orientation to learning*: In this study, the context of the experiment portrayed a real-life situation (safe food management), problem-based scenarios (Week 3) and actual kitchen-based scenarios (Week 4); thus offering a problem-solving orientation rather than a subject-centred orientation. It is therefore argued that this problem-solving orientation made participant DCT relate to the learning process as she described herself as someone who purchases, cooks and eats meat frequently; at least once a week. Thus, as it has been argued that food preparation is strongly gendered in Australia (Wong et al., 2013), it can also be argued that participant DCT regards food preparation as her responsibility which requires her to learn about its safety.
- f. *Motivation to learn*: For participant DCT, she was motivated to learn because she realised that the impact of food-borne diseases on her family could be devastating.

“...because I have a child it is important to avoid diseases”. -
DCT

Despite participant DCT's demonstration of these six principles, the findings reveal that the rate at which she learnt was quite poor. Whilst proponents of the *processing speed theory of cognitive aging*, could have argued that DCT's processing speed was as a result of age changes in memory (Finkel et al., 2007) as DCT is above 50 years, the findings from this research provides evidence against this. The findings from this study reveals that DCT, could remember what was learnt in Week 2 but could not demonstrate better understanding in Week 3 and could not demonstrate a proper application of the knowledge acquired in Week 4. However, she could demonstrate some level of

‘remembrance’ in Week 10; thus portraying the exact opposite of the arguments offered on studies related to cognitive aging.

This is in consonance with the studies suggesting that older participants could demonstrate ‘understanding’ much more than ‘remembrance’ as the effect of age in recollection experience is determined by frontal lobe integrity and not by declining processing speed (Bugaiska et al., 2007, McCabe et al., 2010). Therefore, based on the gathered evidence, participant DCT emanated individual differences which influenced the rate at which her knowledge on safe food management was optimised.

Perspective three - closed-minded cognition: This emerges from section 6.4.3 (participant ACH), where there was no difference between the level of knowledge the participant had at the commencement of the experiment in Week 1 and six weeks after the completion of the 4-week experiment in Week 10. In fact, after using the app in Week 1, she declined in the level of knowledge she could demonstrate by Week 2, though she was given the same questions as Week 1. In addition, she had learnt the correct answers from the app, discussed what she had learnt with others and listened to what others had learnt in Week 1. However, by week 10, she was only able to have the same result as that of Week 1. In addition, it was realised that she kept referring to the wrong information when asked about what she had learnt in Weeks 3 and 4, as shown below:

“wash hands for at least 40s; fridge temperature should be about 3⁰C and; burger should have an internal temperature of about 80⁰C” - ACH

This questions the participant’s safe food management behaviour in her home during and after the experiment. Also, after the 10-Week mark, she was not able discuss tangible behavioural changes she had made in her day to day kitchen activities. All she could refer to was about gaining more awareness, as shown below;

“I am a little more aware of washing things rather than just rinsing them under hot water” - ACH

Thus, this reveals that, despite all the precautions taken to ensure that the participants’ knowledge are optimised (see section 3.3.3), this participant was too confident about the perception of her ability and was quite ignorant about what she did not know which

impeded further learning throughout the course of the experiment. This behaviour portrays the *earned dogmatism hypothesis*. This hypothesis proposes that when individuals perceive themselves to be an expert, they tend to adopt a more closed-minded orientation (Fernbach et al., 2013, Ottati et al., 2015). Participant ACH exhibits this behaviour based on the following reasons;

1. It is believed that she perceives herself as an expert because she had the highest score when quizzed about her prior or baseline safe food management knowledge in Week 1.
2. In Week 10, she ended up with the same knowledge score as that of Week 1, thus showing no increase in the level of knowledge gained. This indicates that she was closed-minded, as she kept repeating the same mistakes even when she had been corrected in Week 1. Therefore, this impeded her ability to learn further.
3. Despite her knowledge and the relatively consistent use of the app, there is insignificant evidence to suggest that there was a tangible corresponding behavioural change.

Thus, based on the gathered evidence, participant ACH exhibited a closed-minded cognitive orientation which influenced the outcome of the knowledge optimisation process throughout the course of the experiment. Therefore, the fourth finding indicates that individual behaviours do influence their knowledge, habit, but more importantly their response to efforts aimed at optimising their knowledge through intervention approach utilised in this study.

6.10 Chapter Summary

This chapter has presented the data analysis that was conducted for the phase three of this research - Implementing and Evaluating the Safe Food Management App and the associated preliminary findings. The analysis of the data in this chapter was done through a range of descriptive statistical diagrams and tables for the closed ended questionnaires while the open-ended questionnaires were manually analysed by checking the correctness of the answers in relation to the information provided in the SFM app or paper-based tool. The focus of this chapter was to present, discuss and interpret the findings of phase three of this research. As the aim of this phase involved the use of a field experiment to investigate how the use of the safe food management app developed in phase 2, influences consumer knowledge acquisition, knowledge retention

and provides a capacity for perceived behavioural change. This research activity aimed to provide answers to the third research question. The chapter has discussed the impact of the activities that occurred in each week of the experiment. It has provided a clear picture of the impact of the experiment on each of the participants. It integrated and discussed the findings of the experiment across the 4 week period. Next, it discussed the level of, and the impact of, the usage of the app or paper-based tool over the period of the experiment. The insights generated from this phase are as follows;

- Food management behaviour is intimately linked to the individual, habit, knowledge and context of use. Thus, it cannot be assumed that the provision of information result to its use or that its use results into utility neither do utility result into safe behaviour.
- The mode of delivering information influences knowledge retention in the context of educating consumers on domestic safe food management.
- Smartphone apps are useful for reinforcement and retention of knowledge over time, to facilitate corresponding behavioural change.
- Regardless of the learning resource, users tend to forget what has been learnt over time. Therefore, it is important to reinforce the acquired knowledge frequently using multiple channels.
- Multiple channels of reinforcement have the tendency to build sustainability of knowledge.
- Although smartphone apps induce some level of cognitive load in adoption (during the first use), there is evidence to suggest that the affordances of re-use for quick but infrequent revisitation facilitates knowledge acquisition and retention. Nonetheless, cues that draw attention to the re-use of such apps, through other information channels could be beneficial.

It is however important to note that this chapter only presented the findings of Phase 3 of the study. The findings presented here in Chapter 6 are discussed and interpreted in light of extant literature in Chapter 7. Please see section 8.3 for broader implications of this research from the substantive, theoretical and methodological perspectives. Moving forward, the next chapter presents the key findings of this research and discusses how these findings have helped to address the research questions being investigated in this study.

CHAPTER SEVEN

**ANSWERING THE
RESEARCH
QUESTIONS - KEY
FINDINGS**

7 ANSWERING THE RESEARCH QUESTIONS – KEY FINDINGS

7.1 Introduction

This chapter presents the five key findings that emerged from this research. The findings are further explored in this chapter and discussed in relation to the available literature and in relation to the research questions and research objectives stated in section 1.2.2. This chapter is divided into the following sections:

- Section 7.2 discusses the key research findings that emerged from this thesis.
- Section 7.3 re-introduces the research questions and the related research objectives. This section provides answers to the research questions and the related research objectives.
- Section 7.4 provides a summary of the chapter.

7.2 Key Research Findings

This section discusses the research findings in relation to the existing literature. These findings have emerged from the preceding chapters, which was derived from chapters 4, 5 and 6. The five findings provide answers to the research questions and the related research objectives (see section 1.2.2).

7.2.1 First Key Finding

Multiple modalities are effective in delivering safe food management information to influence knowledge retention when the information delivery tool is designed based on principles derived from an enhanced version of Monkman and Kushniruk's (2013) HLOH framework.

This research has found that the principle of modality is also applicable within the context of optimising consumers' knowledge on safe food management based on how the information delivery tool is designed. According to Mayer and Chandler (2001), the principle of modality states that “knowledge acquisition is better facilitated by materials presented in a format that simultaneously uses the auditory and the visual sensory modality than by a format that uses only the visual modality” (Brunken et al., 2003). Drawn from the cognitive theory of multimedia learning, the modality effect refers to a cognitive load learning effect that occurs when partly visual and partly auditory

information modes are presented which is more effective than when either of the modes is presented (Mayer, 2005a, Mayer, 2014). This principle was explored in the context of this study by applying not only textual but more importantly visual and auditory information modalities in the app presented to the participants. There are two areas of interest that explain the impact of this principle in the context of this study: educational and social perspectives.

1. Educational perspective: Previously, this principle has been widely used in studies incorporating the cognitive theory of multimedia learning in pedagogical frameworks based on empirical studies on students who are formally enrolled in an educational institution (Harskamp et al., 2007, Tabbers et al., 2004, Leahy and Sweller, 2011, Schmidt-Weigand et al., 2010). However, due to limited research on the application of the modality effect from an adult learning perspective, within the safe food management context, it was imperative to investigate whether the principle is applicable within the context of optimising consumers' knowledge on safe food management. The adult learning model differs from pedagogical models and is more applicable to the participants used in this research due to its focus on adult learners who are different from traditional students in the following ways (De Vito, 2010);

- They are typically aged 24 years or older
- They are not financially dependent on parents or guardians
- Their main responsibilities are outside schooling
- Their principal identities have evolved beyond the role of full-time student.

As the adult learning framework is the art and science of teaching adults based on the six assumptions of self-directedness, need to know, use of experience in learning, readiness to learn, orientation to learning, and internal motivation (Knowles et al., 2014); it is a framework that is appropriate for consumers who handle and prepare food in the home as demonstrated by this study. It has also been identified as an important framework for maximizing learning outcomes within the public health domain (Roebuck et al., 2015). Despite the various ways in which adult learning and adult education are connected to consumption (Sandlin, 2008), very few adult educators have paid attention to the processes of education and learning (Usher, Bryant and Johnston 1997) based on consumers interest in electronic tools. Out of the few, Woods and Rosenberg (2015),

Tainter et al. (2015) and Riella (2016) have argued for technology-driven solutions as strategies for creating better learning opportunities for adults on health related topics. However, little is known on how technology-based tools can be applied from an adult learning perspective within the safe food management space. As such, this study fills this gap.

On the other hand, Aziz et al. (2016) has argued for the effectiveness of the theory of multimedia, which is based on three frameworks (Dual Coding Theory, Working Memory Theory and Theory of Cognitive Load) (Mayer, 2014), and how it can be exploited by adult learners. One of the multimedia instructional principles identified by Mayer (2009) is the modality principle (Sorden, 2012). For the modality principle, various studies have demonstrated the superiority of spoken over written text by observing less mental effort while learning (Tabbers, 2002), less time on problem solving tasks (Jeung et al., 1997), higher scores on various tasks of retention, transfer, practice (Kalyuga et al., 2000) and shorter reaction time in a secondary task (Brünken et al., 2004). Findings from other studies could only partly support the modality effect (Tabbers, 2002, Stiller, 2007), while some others were contradictory (Schmidt-Weigand, 2006).

Based on evidence in the literature, Stiller (2007) has argued that it is not easy to predict the circumstances under which it is better to use visual texts with interactive instructions, because there is also ample evidence of modality effect with such instructions, that have effects seeming to depend on learner characteristics. Hence, it is imperative to specify the characteristics of the instructions and the learners that resulted in the modality effect identified in this study. With reference to the methodology in section 3.3.3 and the data analysis and preliminary findings in sections 6.2, 6.4 to 6.7 and 6.9, the *characteristics of the instructions* comprised of tasks on knowledge retention and knowledge application which was conducted based on equal spacing of post-tests across a period of 4 weeks; while the *characteristics of the learners* is concerned with the features of the adult learners specified in relation to adult learning.

Therefore, while the researcher acknowledges that the modality effect may largely depend on learner characteristics, the study has however revealed the characteristics of the instruction and learners that resulted in the observed modality effect. The specified

characteristics of the learners which differentiates them from traditional students, thus strengthens the argument that the modality effect is also applicable from an adult learning perspective within the safe food management context.

2. Social Perspective: As it has been argued that the manifestation of knowledge through certain behaviour during cognitive and knowledge acquisition processes could enhance knowledge retention (Martins and Martins, 2011), it is believed that behaviours such as social interactions and discussions can facilitate knowledge retention. In line with Dabbagh and Reo (2011), who have used Gibsons's (1977) theory of affordances to argue that social media possess features that users can activate "to enable the degree of interaction and sharing desired and/or required for learning", it is also argued here that the affordances of smartphone apps enable it to be used for social interaction through social media platforms, for learning purposes. As a result, it is believed that such informal interactions have the tendency to reinforce knowledge over time (Ipe, 2003, Soo et al., 2002). However, the results of this research do not necessarily support such belief as evidence of informal interactions did not result in knowledge retention and/or reinforcement (see section 6.9).

Despite the individual facilitation of informal interactions that emanated within this study, the findings reveal that the reinforcement and retention of knowledge over time was not necessarily due to the informal interactions. Thus, it can be argued that when optimising consumers knowledge on safe food management, it is unclear the role in which informal interactions play as this merits further investigation. Nonetheless, as it has been argued within the cognitive theory of multimedia learning, that information presented in multiple formats or modalities is more helpful in facilitating knowledge acquisition for retention over time; this indicates that the multimodal nature of the smartphone app played a role in the retention of knowledge.

Apart from the multimodal nature of the app, it is clear that when the safe food management app was designed based on principles derived from a modified version of Monkman and Kushniruk's (2013) HLOH framework and was used consistently, there was evidence of the reinforcement and retention of knowledge over time. As the information in the app was focused on safe food management, the HLOH framework was modified due to three reasons: *The context of use, the need for sustainability of*

acquired knowledge and the consequences of poor decisions caused by poor knowledge.

These reasons are discussed below.

7.2.1.1 Context of use

Context of use refers to the unique nature of safe food management by consumers. Consumer safe food management involves five processes of safe shopping of perishable food items, safe transportation of perishable food items, safe storage of perishable food items, safe preparation of food items and appropriate kitchen hygiene practices (Henley et al., 2012). One important food product that can compromise the safety of other food items, at any stage of the five processes, is meat. Meat products are high carriers of bacteria (Omurtag et al., 2013), and they have the potential to cause cross-contamination across food items if they are not handled properly. As meat is a major source of concern, many food safety interventions, but more specifically, food safety apps tend to focus on educating consumers on how meat products should be handled.

With education the primary aim, the use of meat images in food safety apps should be considered with caution. As such, when developing food safety apps, how meat images are represented must be considered by ensuring the app does not utilise images which can emanate polarizing views such as the image of a dismembered animal, as stated by design consideration 4 (see sections 5.3 and 5.4). This relates to the recent interest of consumers in animal welfare issues which is connected to their perception of meat quality (Hocquette et al., 2014, De Backer and Hudders, 2015).

7.2.1.2 The need for sustainability of acquired knowledge

The need for sustainability of acquired knowledge refers to end-to-end safe food management apps that are not necessarily reliant on procedural knowledge as they require an understanding of the safety process from the point of purchase to the point of actual consumption. In the five-stage process defined earlier (section 7.2.1.1), consumers (end users) have to understand how to safely undergo the entire process and retain the knowledge for its actual implementation across the stages. As such, it is unrealistic for end-users to continually use apps during most of the five-stage processes (transportation, preparation and kitchen hygiene). For instance, for safe food preparation, using a smartphone app in a kitchen environment may contribute to a higher risk of cross contamination, as it has been argued that mobile phones are one of the biggest carriers of

bacteria (Parhizgari et al., 2014, Orsi et al., 2015), thus making the food being prepared potentially unsafe for consumption.

Therefore, apps should be designed with the intention to reduce technology dependency during the five-stage process of safe food handling by consumers. This aims to ensure that the end users understand the app content and can retain the knowledge acquired over time (sustainability) after using the app for the first few times. To facilitate this, the following identified design considerations are important (see sections 5.3 and 5.4): Ensure the app does not utilise images which can emanate polarizing views; ensure there are other useful resources apart from the primary focus of the app; ensure pictures achieve a single purpose within an appropriate context; ensure appropriate context when using picture to deliver information; avoid the use of sound cues or prompts when communicating information on safe food management; ensure app is visually appealing and not cluttered regardless of the information modality in focus.

7.2.1.3 The consequences of poor decisions due to knowledge gaps

The associated risks with unsafe food management from consumers' point of purchase to the point of actual consumption could indeed lead to unpleasant outcomes. For instance, in Australia, out of the reported cases of food borne outbreaks in 2010, 2146 persons were affected, including 157 hospitalizations and 15 deaths (OzFoodNet, 2012). Apart from commercially prepared food, the consumer home has the highest percentage of food poisoning outbreaks in Australia (OzFoodNet, 2012). As such, apps developed for the purpose of safe food management are important due to the serious consequence of poor decisions caused by lack of knowledge.

Whilst it has been acknowledged that consumers' knowledge (acquired through smartphone apps) does not necessarily translate to corresponding behaviour (safe food management), it can however be argued that future studies that develop apps to ensure consumer understanding and knowledge retention on safe food handling practices, based on insights from this study, will move one step closer to achieving corresponding behaviour.

Thus, five additional app design considerations, for apps that aim to provide information on safe food management practices to consumers, emerged. These include;

1. **Context Appropriate Images:** This principle is concerned with the use of images that are appropriate from the perspective of food consumers, who are also the app users. Specifically, it is important that the app does not include images that can emanate polarizing views such as the image of a dismembered animal. An image may be suitable for the purpose of conveying a message to the app users but care must be taken to ensure other unintended, offensive or confusing messages are not sent to the users. Therefore, the choice of an image must be well thought-out using a broad lens to capture the diversity of perception of the intended users.
2. **Added Value:** This principle refers to the provision of other useful resources in the app, apart from its primary focus. The purpose of these resources may be for the provision of additional information, convenience to the user, context relevant support, technical support or for networking. Whilst these resources are not the primary focus of the app, they must however be relevant to the app's purpose without being overpowering. Thus, there must be a good balance.
3. **Pictures with Unilateral Purpose:** This principle involves the use of pictures that achieve a single purpose within an appropriate context. This includes ensuring that only the appropriate context is alluded to when using picture to deliver information. Pictures may pass across an educational message, a psychological message, an emotional message, other messages or a mixture of some or all of these messages. Therefore, utmost care must be taken to ensure the chosen picture in fact delivers the intended message to the users of the app.
4. **Avoidance of Sound Prompts:** This principle is concerned with the absolute avoidance of the use of sound cues or prompts when communicating information on safe food management. This is important because it is regarded as a source of distraction, thus detracting from the focus of the app. Other modalities of information such as graphics, videos, animations and little amount of texts can be used to communicate information in a more positive manner.

5. **Aesthetically pleasing:** This principle refers to the ‘look and feel’ of the app as it must be visually appealing and not cluttered regardless of the information modality in focus. Whilst this principle might appear generic, it however focuses on the balance required in the choice and use of multiple information modalities on the pages of the app. It is common knowledge that text-based information only is not aesthetically pleasing but this does not guarantee that other information modalities such as graphics, videos and animations are visually appealing regardless of how they are placed on the app pages. Indeed, great attention has to be given to all these information modalities in terms of features such as the layout, colours, image sizes, brightness, audio tone and the responsiveness of the design (portrait versus landscape across multiple devices) to ensure that the app design is visually appealing to the users.

These principles enhance the HLOH framework to make it more robust and comprehensive; thus adapting it to address the safe food management context. Therefore, it is argued that when optimising the knowledge of adult consumers, on safe food management, the design of the information delivery tool is important as it influences the rate at which knowledge is retained. This attests to the applicability of the principle of the modality effect within this research context when the information delivery tool is designed based on principles derived from an enhanced version of the HLOH framework. As a result, this research supports the findings of Mayer (2014) that multiple modalities are effective in delivering safe food management information to influence knowledge retention based on the incorporation of an enhanced Monkman and Kushniruk’s (2013) HLOH framework.

7.2.2 Second Key Finding

The safe food management (SFM) app requires more time to be spent to achieve knowledge acquisition which resulted in retaining the knowledge for a longer period of time than the traditional information delivery techniques.

The researcher draws on the cognitive load theory as the tasks and learning activities in the study required simultaneous integration of multiple and various sets of knowledge, skills and behaviours at a specific time and place (Young et al., 2014). The cognitive load theory (CLT) integrates three key components of the cognitive architecture:

memory systems (sensory, working and long-term memory (LTM)), learning processes and types of cognitive load (intrinsic, extraneous and germane) imposed on working memory (WM) (Sweller, 1988). Extraneous cognitive load refers to the burden imposed on the working memory of the learner which is not essential to the task (Young et al., 2014). This load tends to arise when learners use an app at first sight which leads to a distraction that is not related to the knowledge acquisition task.

As the initial use of a smartphone app induces a higher level of extraneous cognitive load, this places a level of demand on the working memory and reduces the rate at which knowledge acquisition occurs. According to Brunken et al. (2003), extraneous cognitive load occurs due to the format and manner of information presentation and the requirements of the instructional activities on the working memory. However, this type and level of cognitive load does not occur when a traditional information delivery technique is used, as evidenced by this study.

It was however discovered that the app users demonstrated a higher level of knowledge retention over time when compared to the document users. Perhaps, this can be explained by the split-attention effect in relation to the cognitive load theory. This effect involves the phenomenon whereby the physical integration, rather than physical separation, of verbal and pictorial information sources enhances learning (Cierniak et al., 2009). However, when split attention occurs, it increases demands on the learner's working memory (WM) and has the tendency to impact learning negatively (Ayres and Cierniak, 2012). One way to avoid the split attention effect is by externally integrating the different sources of information together into a single integrated source of information (Ayres and Cierniak, 2012) as was achieved with the safe food management app. It is believed that this strategy was instrumental to the successful outcome of the level of knowledge retention emanated by the participants.

The app contained videos of safe food management practices that incorporated the modality effect as the visual figures are linked with auditory (spoken) rather than visual (written) elements (Mayer, 2005b). Mayer (2005b) has argued that the modality effect can only occur under the condition in which the multiple sources of information are unintelligible in isolation and rely on each other for intelligibility to avoid the redundancy effect. This condition was met by the videos included in several pages of the

app as they comprised of picture frames (visual elements) and spoken elements that rely on each other for intelligibility; thus complementing the features portrayed by one another (Liu et al., 2012, Mayer et al., 2001).

Initially, more time was spent on the app used in this study but the rate at which information and/or knowledge was acquired was lower than that of document users. However, more in-depth details revealed that the app users acquired the knowledge slowly but retained it longer in contrast to the document users. These findings are in line with the study conducted by Herrlinger et al. (2016) and Leahy and Sweller (2011) who have argued that pictures and spoken text enhanced learning better than written text. Similar to this finding is the study conducted by Wang et al. (2016) which revealed that when more attention was paid to the video and less attention paid to the text there was better retention of the learning outcomes. However, the findings in this study differ from those of Chandler and Sweller (1992) who found that students viewing integrated instruction spent less time processing the materials as the app users in this study spent more time acquiring the knowledge due to the extraneous cognitive load which occurred due to the additional learning that was required for the initial use of an app. Nonetheless, Chandler and Sweller (1992) also agreed that students viewing integrated instruction outperformed those with split attention condition. On the other hand, the findings are in line with the study conducted by Schmidt-Weigand et al. (2010) who also revealed that participants showed a better learning performance the more time they spent looking at visualizations when text was spoken and integrated.

Therefore, in consonance with Schmidt-Weigand et al. (2010), it can be argued that the time devoted to process visualizations with spoken and integrated text such as videos may be an indicator of the quality of processing this information. From this perspective, this study suggests that the time a learner spends in using an app containing visualizations with spoken and integrated text such as it is featured in the safe food management (SFM) app, during the information and/or knowledge acquisition phase, may be advantageous in facilitating knowledge retention for a longer period of time than traditional information delivery techniques.

7.2.3 Third Key Finding

Smartphone apps induce some level of cognitive load in adoption however; the affordance of its reuse for quick but infrequent revisitations facilitates knowledge retention.

This research has found that the initial use of the smartphone app which was developed for information and/or knowledge acquisition purposes induces a higher level of extraneous cognitive load; thus reducing the rate at which knowledge is acquired during the first use. According to Brunken et al. (2003), extraneous cognitive load occurs due to the format and manner of information presentation and the requirements of the instructional activities on the working memory. Cognitive load was discovered in this study as evidence suggests that participants using the app experienced a level of demand on the working memory. Based on the previous arguments from Moreno and Mayer (2005), that the principle of modality effect can indeed reduce extraneous cognitive load for knowledge acquisition tools developed on mobile devices, this study incorporated the principle. Yet, the results indicate that some level of cognitive load was induced. Although the evidence is lacking, it appears to this researcher that the HLOH framework seem to have minimized the cognitive burden. Thus, there was a better demonstration of knowledge retention after the app has been reused over a short period of time (see section 6.6). When participants spent less time on the smartphone app after the initial use, they demonstrated better retention of knowledge whereas spending more time on the paper-based tool resulted in poorer retention of information and/or knowledge (see section 6.8).

This finding is in line with the temporal patterns that have been identified in the usage of smartphones and their applications which suggests short bursts of smartphone interactions (Jones et al., 2015). For instance, Yan et al. (2012) found that mobile phone usage is brief as half of mobile phone engagement (time between unlocking and relocking) lasts less than 30 seconds. Similarly, Ferreira et al. (2014) found that some apps are used in short bursts of less than 15 seconds. Also, a large scale study by Böhmer et al. (2011) revealed that smartphone devices are used for an average of 59 minutes daily while an average application session lasts 72 seconds. With a focus on overall smartphone users' habits, Oulasvirta et al. (2012) suggest that smartphones are "habit-forming" devices as users emanate the "checking habit" through brief inspection

of content quickly accessible on their smartphones. A follow up study by Ferreira et al. (2014) revealed that this habit is one of the behavioural characteristics that leads to short bursts of interactions with applications. In addition, this habit has largely been focused on users making quick revisits to applications that contain fast changing content (Ferreira et al., 2014, Oulasvirta et al., 2012). However, Jones et al. (2015) has argued that apps that relate to personal activities such as food handling and food management follow a slow revisitation pattern. As such, this explains the slow revisitation pattern and the little time spent on the safe food management app during its subsequent use in this study. Thus, as this facilitated a better demonstration of knowledge retention on safe food management, it suggests that the affordance of re-use for quick but infrequent revisitations facilitates knowledge retention.

Therefore, as it has been earlier argued that multiple information channels enhance food safety information dissemination (Kuttschreuter et al., 2014), it can be further argued that other information channels such as TV adverts, brochures, pamphlets and other media can be useful in drawing attention to the reuse or revisitation of such smartphone apps to reinforce and support the retention of consumers knowledge. This indicates that optimising consumers' safe food management knowledge cannot be a one-off activity as they require cues that prompt them into revising the app so as to maintain adequate knowledge level from time to time.

7.2.4 Fourth Key Finding

The use of a modified user centred design approach, using a heuristic framework with consumer evaluation outputs as a basis for app development, can support the development of a safe food management app.

This research has found that a non-conventional software methodology can successfully deliver a safe food management app. Of the existing software design methodologies for app development related to the eHealth context, user-centred design methods are commonly used in contemporary design and, in particular, consumer-oriented products (Cafazzo et al., 2012). User centred design (UCD) methods are regarded as an evidence-based approach informed by the needs and understanding of a specific end user-group (McCurdie et al., 2012). It entails the iterative involvement of the end user in the design process by eliciting formal feedback on prototype versions; heuristic evaluation; and

formative usability testing of the system (Cafazzo et al., 2012). Specifically, the conventional approach to UCD involves conducting usability evaluation as the final stage of the design cycle (Abrams et al., 2004, Rogers et al., 2011a).

However, this research modified the conventional user centred design approach by combining the outcome of a heuristic evaluation based on a health literacy online heuristics (HLOH) framework (Monkman and Kushniruk, 2013) and a consumer-based evaluation through a focus group session as a basis for the app development. Prior to the development of the safe food management app, existing apps were selected and used for the heuristic evaluation and the consumer-based evaluation. As the focus for phase two of the research (*see chapter 5*) involved the selection of three existing apps (text-based, graphics/picture-based and integrated) that most clearly addressed the safe food handling practice being targeted, it was imperative to learn from these apps before developing another to avoid re-inventing the wheel. Apart from this, the existing apps were selected for the following reasons:

- Easy and low cost investigation of three different information modalities that support users (non-technical; food consumers) to become rapidly familiar with the three modalities thereby enabling them to contribute to subsequent preferences for design by having provided them with some concrete examples to work from in the first instance (Houde and Hill, 1997).
- A more effective collection of true human performance data as there is evidence to suggest that a high-fidelity prototype/fully functional prototype provides a more valid evaluation than a paper or low fidelity prototype (Lim et al., 2006).
- There is also a precedent for this type of approach in developing mobile solutions using existing applications (Fleury et al., 2010).

As it has been argued that UCD is a group of methods that focus on designing for and involving users in the development of systems, it has also been argued that involving users in the design one way or the other leads to developing more usable satisfying designs (Abrams et al., 2004). Thus, from this perspective, it is argued that the approach utilised in this research, though modified, can also be classified as a method that conforms with the basic principle of UCD as actual consumers or end-users were

involved in the evaluation of existing apps which led to the concept design (section 5.5) for the development of the safe food management app as demonstrated in Figure 7-1.

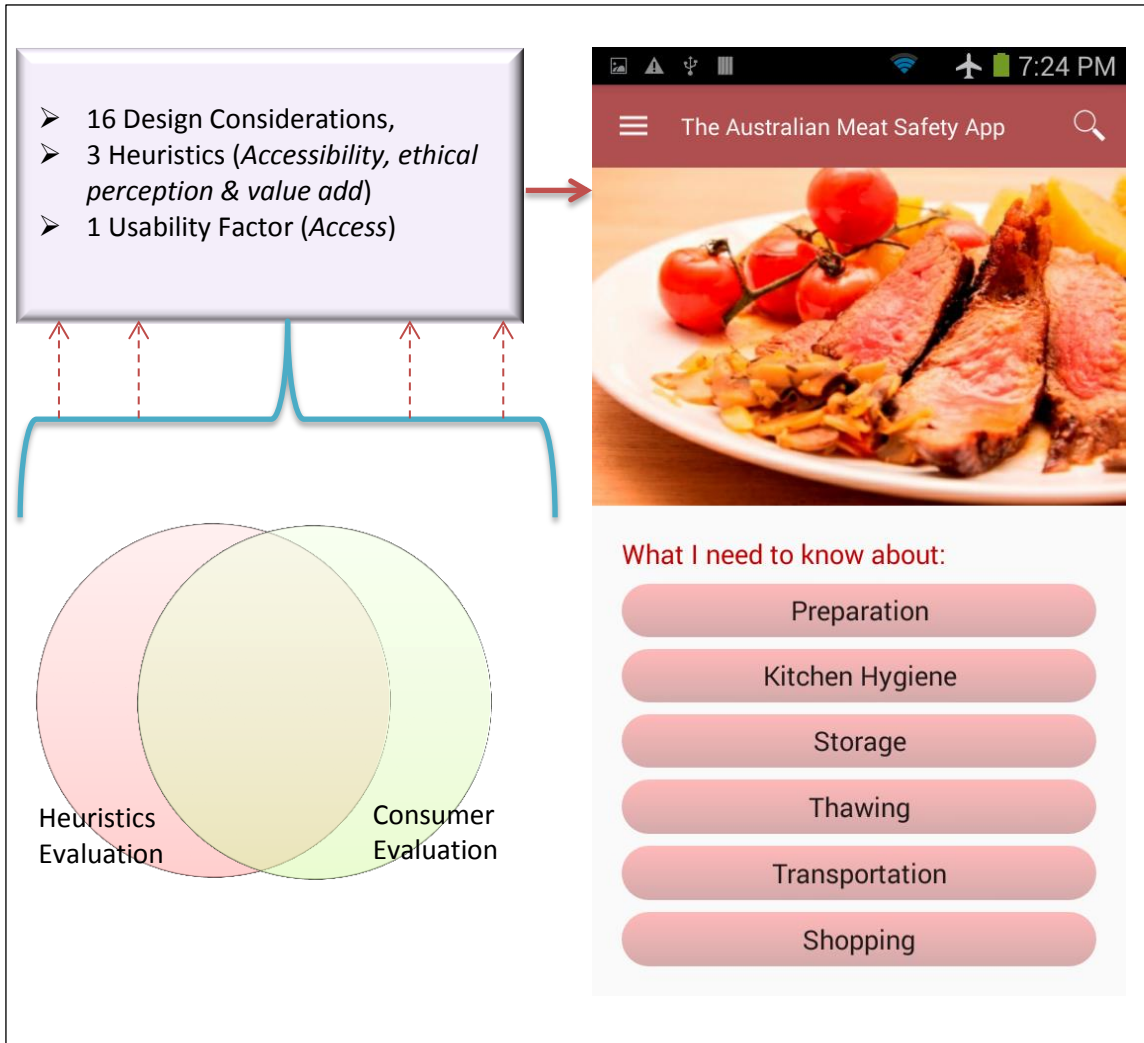


Figure 7-1: A modified user centred design approach

Therefore, in consonance with the approach utilised by Fleury et al. (2010), it can be argued that a non-conventional approach to UCD using a heuristic framework combined with consumer evaluation outputs, as a basis for app development, can successfully produce a knowledge acquisition tool that is useful within a well-established information campaign space on safe food management (SFM). This non-conventional approach to UCD can be referred to as an inverted user centred design approach.

7.2.5 Fifth Key Finding

Food related behaviour is intimately linked to the individual's attributes, habit, knowledge and context of use as the provision of safe food management information does not necessarily result into its use, corresponding knowledge or expected behaviour.

This research has found that the skills and attributes of individuals influence how they respond to efforts made at optimising their knowledge. As there are different types of consumers with diverse attributes such as age, gender, technology skills and food preparation skills, it is imperative to take these and other relevant factors into consideration. It has been earlier argued in section 3.3.3.3, that age and gender are important factors and that they have the potential to influence technology and food preparation skills. However, other factors that have been identified include perceived personal relevance, cognitive functioning and overconfidence which will be discussed subsequently.

7.2.5.1 Perceived Personal Relevance

Evidence from this research indicates that some consumers may not necessarily believe that the information in a safe food management app is objectively personally relevant to them; as having access to useful information does not mean it would be used. The results suggest that for knowledgeable, skilled and experienced consumers who are domestic food handlers, that tend to be characterised as frequent cooks; their process of food handling and preparation is usually based on peripheral processing thus they do not tend to think that information on safe food management is objectively personally relevant to them (Dijkstra and Ballast, 2012). However, they tend to realise that the mismanagement of food products at home can compromise its safety which can lead to food poisoning. It is therefore argued that this type of consumers make low to medium involvement decisions based on their low level of perceived personal relevance due to their skills and experience; and their awareness of the risk of wrong decisions due to their knowledge of food safety.

These findings thus shed more light on the impact of low to high involvement decisions on safe food management and handling. As van Trijp (2009) has earlier argued that low involvement decisions are characterised by limited investment of time and effort into information processing. Low involvement decisions do not usually involve high levels of

perceived personal relevance and risk of wrong decisions (Hamlin, 2010, Insch and Jackson, 2013). Therefore, it can be argued that consumers with a reasonable level of knowledge, in terms of high level of education, more specifically on food related information and technology skills, tend to relate with safe food management information provided in an app as a low to medium involvement task whereas consumers with a lower level of knowledge tend to relate with such information as a medium to high involvement task.

Whilst previous studies (Besler et al., 2012, Grunert et al., 2010, van Trijp, 2009, Liu et al., 2015, Cheong et al., 2013, Song et al., 2015) have focused on consumer understanding of food nutrition information on food labels, which places emphasis on food purchase decisions – a low involvement task, there is little research on consumer understanding of food safety information, which places emphasis on post-purchase domestic food handling and management – a medium to high involvement task. Therefore, this research has uncovered a gap in our knowledge on consumer knowledge optimisation and the corresponding translation into safe food management behaviour which appears to be a medium to high involvement task for consumers with a lower level of knowledge; thus requiring further research.

Therefore, it can be argued that *the provision of safe food management information does not necessarily result in the use of such information* most especially in cases where consumers believe that the available safe food management information is not objectively personally relevant to them.

7.2.5.2 Individual Differences Moderating Adult Learning

Despite some participant demonstration of the six key principles of adult learning, they emanated individual differences that influenced the poor rate at which their knowledge was optimised. This conforms with the argument provided by De Vito (2010) that individual differences is one of the factors that affect adult learning (see section 6.9). One of the individual differences that was explored in this study is cognitive aging. According to the *processing speed theory of cognitive aging*, it could be argued that poor processing speed and poor rate of knowledge optimisation was as a result of age changes in memory (Finkel et al., 2007). This is in consonance with the studies suggesting that older participants could demonstrate ‘understanding’ much more than ‘remembrance’ as

the effect of age in recollection experience is determined by frontal lobe integrity and not by declining processing speed (Bugaiska et al., 2007, McCabe et al., 2010). However, the findings of this study does not support such argument as the results completely contradict the arguments offered on studies related to cognitive aging as described above.

Therefore, based on the results of this research, some participants emanated individual differences which influenced the rate at which their knowledge on safe food management was optimised. Thus, it can be argued that *the use of information does not necessarily result in corresponding knowledge* as there are other individual factors that can influence the value derived from a knowledge optimisation process.

7.2.5.3 Closed-Minded or Dogmatic Cognition

This research reveals that, despite all the precautions taken to ensure that the participants' knowledge are optimised (see section 3.3.3), some participants appeared confident about the perception of their ability and they appeared ignorant about what they did not know which impeded further learning. This phenomenon seems similar to the Dunning-Kruger effect (Dunning, 2011) and areas where it is different will be highlighted subsequently. According to Kruger and Dunning (1999), people who emanate such pervasive overconfidence, are overly optimistic about their social and intellectual abilities so much so that they suffer a dual burden. First, they reach erroneous conclusions and they make unfortunate choices. Second, they lack the metacognitive ability to realize their poor decisions; thus leading to repeated mistakes.

Whilst Dunning (2011) and Ehrlinger et al. (2008) have consistently argued that this phenomenon only occurs to poor performers, the researcher does not agree with such characterisation in the context of this research. This research has uncovered evidence of participants who are high performers, but poor learners who exhibits overconfidence due to their inability to improve overtime. Therefore, such behaviour is more in line with the argument made by Fisher and C Keil (2015) that those who possess a high level of knowledge within a certain domain, have the tendency to exhibit a relatively high level of overconfidence. Perhaps, it is this level of overconfidence that made some participants *closed-minded* towards the learning process in this study.

According to Ottati et al. (2015), closed-minded or dogmatic cognition, is the tendency to process information in a way that reinforces the person's prior opinion or expectation. To examine one of the factors influencing open-minded cognition, Ottati et al. (2015) defined an expert as someone who is relatively knowledgeable within a domain. With reference to this definition, Trafimow and Snizek (1994) has argued that those who believe they are experts tend to over-estimate the accuracy of their beliefs. Moreover, Ottati et al. (2015) believes that social norms entitle experts to exhibit a more dogmatic cognitive style; thus explaining the *earned dogmatism hypothesis*. This hypothesis proposes that when individuals perceive themselves to be an expert, they tend to adopt a more closed-minded orientation (Fernbach et al., 2013, Ottati et al., 2015). Those who exhibit this behaviour are characterised as follows;

1. They perceive themselves as experts due to their prior knowledge on the topic of discourse.
2. They fail to learn further as they have become closed-minded towards new knowledge.
3. Regardless of how often the information and/or knowledge acquisition tool is utilised, they fail to emanate tangible corresponding behavioural change due to the new knowledge they are expected to have acquired.

Thus, the findings in this research *indicates that even when safe food management information is used and it leads to corresponding knowledge, it does not necessarily mean that it would lead to expected behaviour* due to the cognitive orientation adopted by the individual.

Therefore, this research aligns with the argument of Guerrero et al. (2009) that food related behaviour is intimately linked to the individual's attributes, habit, knowledge and context of use. Thus, the provision of safe food management information does not necessarily result into its use, corresponding knowledge or expected behaviour.

7.3 Research Questions and Answers

This section re-introduces the research questions and the objectives to provide a focus in this chapter. This research investigates how the affordances of smartphone technology can be leveraged to enhance the provision of information and facilitate knowledge retention. Thus, this study aimed to provide insights into how best to share information

to facilitate knowledge retention through the use of technology in an attempt to improve the food management behaviour of Australian consumers. From this research, five key findings were identified and discussed in section 7.2 with reference to available literature. These key findings have provided significant insights into the aim and objectives of this research and will now be used to address the research questions and associated research objectives.

7.3.1 The Extent to which Food Safety Knowledge Gaps exist in Consumers

The first research question and associated research objectives are listed as follows:

Research Question 1: To what extent do gaps exist in consumers' food safety knowledge?

As it has been earlier established that gaps do exist in consumers' food safety knowledge, in various developed countries but more specifically in Australia (see section 2.1.4.7), it was imperative to investigate the extent to which these gaps exist and to identify specific problem areas. To address this question, a dual-approach was undertaken to provide a clearer picture of the extent of the food safety knowledge gaps that exist within the Australian context.

The first approach considered the role played by a source of food safety information – food business – to update their consumers on the food safety situation, when a food recall incident occurred. The information transparency landscape between a food business and its consumers must first be understood to successfully determine potential sources of food safety knowledge gaps. Identifying sources of the problem assists in providing insights into how best to address the situation.

The second approach investigated food safety knowledge gaps in consumers, not only during a food incident but, more broadly during normal day to day activities which involves safe food management. This includes; safe shopping of perishable food items, safe transportation of perishable food items, safe storage of perishable food items, safe preparation of food items and appropriate kitchen hygiene practices. Identifying the problem areas and using a broad lens which is not limited to when a food incident occurs, assists in providing solutions that target the problem.

Research Question 1 Objective 1: To determine the role played by a food firm in updating consumers' food safety knowledge during a food recall incident.

Based on the case study conducted with an Australian premium food manufacturing company that experienced a recall in 2014, the investigation confirmed that the existing Australian food recall response mechanisms, at the time of study, did not guarantee a closed loop of communication with all purchasers of a recalled product.

From the firm perspective, it emerges that recovery from a food incident relies on a number of factors including pre-existing brand reputation, effective information management, control mechanisms and supply chain partner response. *First*, findings demonstrating supply chain partner response as a factor, revealed some information restrictions that occurred within the firm's supply chain; thus indicating that there is some industry resistance to improved information transparency. In this case, the supply chain partners permitted no information sheets on shelves; thus, this drew more attention towards investigating how best to deliver information through technology-based channels.

Second, findings demonstrating information management as a factor reveals that information management cannot be over-emphasised, as supply chain stakeholders are required to disseminate information to government authorities and the general public in order to reduce the likelihood that affected products are consumed. When this case study was conducted, the recall process utilised newspapers, television, radio as well as the webpages of the businesses concerned and that of the Australian Competition and Consumer Commission. Whilst this "information-push" strategy was relatively effective in ensuring that potentially unsafe products were removed from distribution and retail outlets, the system did not extend to formal actions involving consumption and relied primarily on an implicit 'hope' that consumers, who had purchased the products would learn of the recall and not consume the product for which the recall action was raised. Therefore, the existing recall response mechanisms, at the time this investigation was conducted, did not guarantee a closed loop of communication with all consumers who had purchased a recalled product.

Based on the firm perception of the consumer perspective, it is evident that consumers' responses are influenced by a wide range of factors that require sensitivity in terms of the choice of information modality and information delivery channel adopted to enhance communications during food recall. There are two instances demonstrating this.

- *First*, while the firm demonstrates authenticity as a value, which translates to provenance, from the consumers' point of view, it is however limited by the amount of textual information that can be placed on labels. Even without this limitation, it is difficult to continuously update textual information after the product has been purchased.
- *Second*, when the firm experienced the recall situation, it became sceptical about updating end consumers regarding the safety status of their food products after the problem had been rectified in order to avoid negative perception. Perhaps, this was as a result of the media involvement. This raises questions about the appropriateness of the information delivery channel for communicating with consumers about sensitive issues as the firm wanted to update the consumers but could not do so. Nonetheless, it indicates that the consumers were not updated after the safety situation was resolved.

Therefore, the sources of the knowledge gaps that consumers experienced during the food recall situation is four-fold: industry resistance to improved information transparency; inadequate government recall response mechanism; inappropriate information modality utilised by the firm and; inappropriate information delivery channel.

Research Question 1 Objective 2: To identify safe food management knowledge gaps in consumers.

With reference to the consumer focused survey that was conducted in 2015, the investigation confirmed that consumers have sub-optimal knowledge in all the five areas investigated; safe shopping of perishable food items, safe transportation of perishable food items, safe storage of perishable food items, safe preparation of food items and

appropriate kitchen hygiene practices. However, the worst problem areas were preparation; kitchen hygiene practices and storage respectively (see section 4.3.6).

As mitigating food safety risks during the process of consumption (post-purchase), which entails domestic safe food management from the point of purchase (purchase) to the point of actual consumption (plate), is largely the responsibility of consumers, it is imperative to empower consumers to facilitate the optimisation of their knowledge (see section 4.2.2).

To answer research question one, this research finds that massive gaps exist in the food safety knowledge of Australian consumers during normal day-to-day kitchen activities in terms of food preparation, storage of perishable food items, appropriate kitchen hygiene practices, safe transportation and shopping of perishable food items respectively. In addition, more gaps exist in food safety knowledge of Australian consumers, who have purchased unsafe food products that have been recalled, due to industry resistance to improved information transparency; inadequate government recall response mechanism; inappropriate information modality utilised by the firm and; inappropriate information delivery channel.

Therefore, having identified the safe food management knowledge gap areas, steps can be taken to facilitate the optimisation of consumer knowledge: by providing the right information – that is information focused on the worst problem areas; from a trusted information source – that is best practice guidelines from government authorities; in a variety of information modalities – that is textual, visual, verbal and integrated; through the appropriate information delivery channels – that is both the traditional media such as a paper-based resource and the online media such as a smartphone application; and to the target audience – that is participants within Australia.

7.3.2 Considerations for Developing a Safe Food Management App to Address Consumers' Knowledge Gaps

The second research question and associated research objectives are listed as follows:

Research Question 2: How can technology support the delivery of food safety information to consumers in a manner that facilitates better understanding?

As RQ1 has identified the extent to which gaps exist in consumers' food safety knowledge outside food incidents but during normal day to day food handling activities, it is important to empower consumers in order to facilitate the optimisation of their knowledge. To achieve this, it was important to develop an app in ways that could allow the benefits of a variety of information modalities and information delivery channels to be explored. This resulted in using a paper-based tool as a baseline and a smartphone app.

First, the paper-based tool was developed based on the rationale that participants recruited within the location of this study might not be technology savvy, as Tasmania had the least proportion of household with internet access when compared to other states and territories within Australia in 2012-2013 (ABS, 2014). Thus, it was imperative to develop a paper-based tool that presented information through text as a baseline. Therefore, the document was the information delivery channel, while written text, was the information modality in focus.

Second, drawing on Mayer and Chandler (2001), the principle of modality effect states that "knowledge acquisition is better facilitated by materials presented in a format that simultaneously uses the auditory and the visual sensory modality than by a format that uses only the visual modality" (Brunken et al., 2003). Thus, it was imperative to develop a smartphone app that presented information through text, pictures and videos. Therefore, the smartphone was the information delivery channel, while text, pictures and videos were the information modalities for this technology-based tool. To ensure that the developed tool meets the best practice standards, it was important to first identify whether the context of investigation – safe food management – required design principles that should be combined with existing generic app design principles. This was done by adopting a health literacy online heuristics framework and combining it with a consumer-based evaluation to holistically assess the usability of existing food safety applications, their contexts of use and attributes of the end-users. This resulted in the identification of the differences in design principles as highlighted in the first key

finding which refers to the enhancement of Monkman and Kushniruk's (2013) HLOH framework by adding principles that should be considered when designing apps in the safe food management (SFM) space. Having identified these differences, the smartphone app was successfully developed using a modified user centred design approach as indicated by the fourth key finding which states that an app was developed based on a non-conventional software methodology using a heuristic framework with consumer evaluation outputs as a basis for app development within a well-established information campaign space on safe food management (SFM).

Research Question 2 Objective 1: To identify whether and how safe food management app designs differ from generic app design principles.

According to the first key finding, the design and use of food safety apps differs from that of generic app design principles in the context of use, the need for sustainability of acquired knowledge and the consequences of poor decisions due to knowledge gaps (see section 7.2.1 for details). The 5 additional design principles that were identified are as follows (see sections 5.3 and 5.4);

1. **Context Appropriate Images:** This principle is concerned with the use of images that are appropriate from the perspective of food consumers, who are also the app users. Specifically, it is important that the app does not include images that can emanate polarizing views such as the image of a dismembered animal. An image may be suitable for the purpose of conveying a message to the app users but care must be taken to ensure other unintended, offensive or confusing messages are not sent to the users. Therefore, the choice of an image must be well thought-out using a broad lens to capture the diversity of perception of the intended users.
2. **Added Value:** This principle refers to the provision of other useful resources in the app, apart from its primary focus. The purpose of these resources may be for the provision of additional information, convenience to the user, context relevant support, technical support or for networking. Whilst these resources are not the primary focus of the app, they must however be relevant to the app's purpose without being overpowering. Thus, there must be a good balance.

3. **Pictures with Unilateral Purpose:** This principle involves the use of pictures that achieve a single purpose within an appropriate context. This includes ensuring that only the appropriate context is alluded to when using picture to deliver information. Pictures may pass across an educational message, a psychological message, an emotional message, other messages or a mixture of some or all of these messages. Therefore, utmost care must be taken to ensure the chosen picture in fact delivers the intended message to the users of the app.

4. **Avoidance of Sound Prompts:** This principle is concerned with the absolute avoidance of the use of sound cues or prompts when communicating information on safe food management. This is important because it is regarded as a source of distraction, thus detracting from the focus of the app. Other modalities of information such as graphics, videos, animations and little amount of texts can be used to communicate information in a more positive manner.

5. **Aesthetically pleasing:** This principle refers to the ‘look and feel’ of the app as it must be visually appealing and not cluttered regardless of the information modality in focus. Whilst this principle might appear generic, it however focuses on the balance required in the choice and use of multiple information modalities on the pages of the app. It is common knowledge that text-based information only is not aesthetically pleasing but this does not guarantee that other information modalities such as graphics, videos and animations are visually appealing regardless of how they are placed on the app pages. Indeed, great attention has to be given to all these information modalities in terms of features such as the layout, colours, image sizes, brightness, audio tone and the responsiveness of the design (portrait versus landscape across multiple devices) to ensure that the app design is visually appealing to the users.

These principles were incorporated into the design of the smartphone app. They were not applicable to the paper-based tool.

Research Question 2 Objective 2: To design and develop a safe food management smartphone app.

While the smartphone app contained the same textual information as it was in the paper-based tool, it also contained pictures and videos from the same agencies. However, the

design of the app incorporated not only the generic app design principles but also the newly identified principles that are mainly applicable to the context of this research – safe food management (see section 5.4, 5.5 and 5.6). More importantly, the app was successfully developed based on a modified user-centred design approach as highlighted in the fourth key finding which states that an app was developed based on a non-conventional software methodology using a heuristic framework with consumer evaluation outputs as a basis for app development within a well-established information campaign space on safe food management (SFM).

Therefore, to answer research question two, this research finds that technology, through a smartphone app, developed based on a modified user-centred design approach using both the generic and the specific design principles associated with safe food management, can support the delivery of food safety information to consumers in a manner that facilitates better understanding.

7.3.3 Determining the influence of the safe food management app on knowledge acquisition, knowledge retention and perceived behavioural change

The third research question and associated research objectives are listed as follows:

Research Question 3: How does the use of a safe food management app influence consumer knowledge acquisition, knowledge retention and perceived behavioural change?

As the overarching aim of the research is to provide insights into how best to share information to facilitate knowledge retention through the use of technology in an attempt to improve the food management behaviour of Australian consumers, it was imperative to investigate the influence of the safe food management app on consumers. Thus, it was first important to understand the participants in terms of how their use of the smartphone app influences their knowledge acquisition and knowledge retention.

Whilst two tools (paper-based and app) were involved in the study, the focus was on the app as the paper-based tool was used as a baseline, which contained textual information modality only but the app contained multiple information modalities (text, pictures and videos). Therefore, there was a need to understand what difference the app would make

towards knowledge acquisition and knowledge retention when optimising the safe food management knowledge of consumers.

Having understood the impact of the app on knowledge acquisition and knowledge retention, it was important to investigate whether and how the retained knowledge influences the consumers' perception of their capacity for behavioural change. This helped to provide insights into how best to share information to facilitate knowledge retention through the use of technology in an attempt to improve the food management behaviour of Australian consumers.

Research Question 3 Objective 1: To determine the impact of the app on consumer knowledge acquisition and knowledge retention.

As earlier stated, this objective is focused on what difference the technology-based tool (smartphone) would make towards knowledge acquisition and knowledge retention when optimising the safe food management knowledge of consumers. The findings of the experiment reveals that the principle of modality effect can be applied to this research context as highlighted by the first key finding which states that multiple modalities are effective in delivering safe food management information to influence knowledge retention when the information delivery tool is designed based on principles derived from an enhanced version of Monkman and Kushniruk's (2013) HLOH framework.

To determine how this principle influences knowledge retention, this key finding also indicates that when a smartphone app, with multiple information modalities, is designed in line with both the generic and the safe food management design principles identified in section 5.7 and when the app is used consistently, this increases the level of knowledge retention of consumers on safe food management. This finding however raises questions on the role in which informal interactions play in knowledge retention as discussed within the first key finding (*multiple modalities are effective in delivering safe food management information to influence knowledge retention when the information delivery tool is designed based on principles derived from an enhanced*

version of Monkman and Kushniruk's (2013) HLOH framework) but confirms that when smartphone apps are designed appropriately as stated by the fourth key finding (*the use of a modified user centred design approach, using a heuristic framework with consumer evaluation outputs as a basis for app development, can support the development of a safe food management app*) and when the app is revisited quickly but infrequently as stated in the third key finding (*smartphone apps induce some level of cognitive load in adoption however; the affordance of its reuse for quick but infrequent revisitations facilitates knowledge retention.*), they can be useful for the reinforcement and retention of knowledge over time when aiming to optimise consumer knowledge.

To determine how the app influences both knowledge acquisition and knowledge retention, the second key finding (*the developed safe food management (SFM) app requires more time to be spent to achieve knowledge acquisition which resulted in retaining the knowledge for a longer period of time than traditional information delivery techniques*) reveals that the safe food management app requires more time to be spent to achieve knowledge acquisition which resulted in retaining the knowledge for a longer period of time than traditional information delivery techniques. On the one hand, the finding revealed that the app induced a higher level of extraneous cognitive load, thus placing a level of demand on the working memory and this resulted in requiring more time to achieve knowledge acquisition. On the other hand, the finding suggests that the time a learner spends in using a knowledge acquisition tool containing visualizations with spoken and integrated text during the information and knowledge acquisition phase may be advantageous in facilitating knowledge retention for a longer period of time than traditional information delivery techniques.

Research Question 3 Objective 2: To determine the impact of the app on perceived behavioural change.

Based on the experiment conducted and the method of investigation (see section 3.3.3), the findings reveal that food related behaviour is intimately linked to the individual's attributes, habit, knowledge and context of use. Thus, the provision of safe food management information does not necessarily result into its use, corresponding knowledge or expected behaviour as highlighted by the fifth key finding (*food related behaviour is intimately linked to the individual's attributes, habit, knowledge and*

context of use as the provision of safe food management information does not necessarily result into its use, corresponding knowledge or expected behaviour) in three ways (see section 7.2.5);

- The individual's perceived personal relevance (section 7.2.5.1)
- Individual differences moderating adult learning (section 7.2.5.2)
- The individual's orientation towards cognition – closed-minded cognition (section 7.2.5.3)

Thus, this indicates that, apart from age and gender (see section 3.3.3.3), other skills and attributes of individuals' influence how they respond to an app aimed at optimising their knowledge on safe food management.

Therefore, to answer the third research question, this research finds that the app induced a higher level of extraneous cognitive load, thus placing a level of demand on the working memory and this resulted in requiring more time to achieve knowledge acquisition. However, it also reveals that the time a learner spends in using the app which contained visualizations with spoken and integrated text during the information and/or knowledge acquisition phase may be advantageous in facilitating knowledge retention for a longer period of time than traditional information delivery techniques. In addition, it reveals that skills and attributes of consumers influence how they respond to a safe food management app due to their perceived personal relevance, individual differences moderating adult learning and orientation towards cognition.

7.4 Chapter Summary

This chapter has presented an interpretation and discussion of five key findings which emerged from integrating the findings obtained in the previous chapters. This chapter has also addressed the research questions and associated research objectives. The key findings in this chapter are subsequently summarised and the limitations of the research approach is discussed in Chapter 8 – see section 8.4.1.

First, the researcher considered both the educational and social perspectives before arguing that when optimising the knowledge of adult consumers, on safe food management, the mode of delivering information is important as it influences the rate at which knowledge is retained. This argument thus attests to the applicability of the

principle of modality effect within this research context. As a result, this research supports the findings of Mayer (2014) that multiple modalities are effective in delivering safe food management information to influence knowledge retention when the information delivery tool is designed based on an enhanced version of Monkman and Kushniruk's (2013) HLOH framework. The importance of the information being delivered is based on the context of use, the need for sustainability of acquired knowledge and the consequences of poor decisions caused by knowledge gaps. This led to the identification of five additional app development considerations or design principles that should influence apps that aim to provide information on safe food handling practices to consumers which are stated as follows: Ensure the app does not utilise images which can emanate polarizing views; ensure other useful resources are provided apart from the primary focus of the app; ensure pictures achieve a single purpose within an appropriate context to deliver information; avoid the use of sound cues or prompts; ensure app is visually appealing and not cluttered regardless of the information modality in focus.

Second, it was argued that the time devoted to process visualizations with spoken and integrated text such as videos may be an indicator of the quality of processing this information. Therefore, the second key finding suggested that the time a learner spends in using a smartphone technology-based tool containing visualizations with spoken and integrated text such as it is featured in the safe food management (SFM) app, during the information and knowledge acquisition phase, may be advantageous in facilitating knowledge retention for a longer period of time than traditional information delivery techniques. This led to the claim that the safe food management (SFM) app requires more time to be spent to achieve knowledge acquisition which resulted in retaining the knowledge for a longer period of time than traditional information delivery techniques.

Third, it was revealed that the slow revisitation pattern and the little time spent on the safe food management app during subsequent use facilitated a better demonstration of knowledge retention on safe food management. Thus, it follows that although, smartphone apps induce some level of cognitive load in adoption; the affordance of quick but infrequent revisitations over a short period of time facilitates knowledge retention. Therefore, it was further argued that other information channels such as TV adverts, brochures, pamphlets and other media can be useful in drawing attention to the

revisitation of such apps to reinforce and support the retention of consumer knowledge. This indicates that optimising consumers' safe food management knowledge cannot be a one-off activity as they require cues that prompt them into revising the knowledge acquisition tool so as to maintain adequate knowledge level from time to time.

Fourth, it was also argued that the software methodological approach utilised in this research, though modified, can also be classified as a method that conforms to the basic principle of user centred design (UCD). Thus, it was further argued that a non-conventional approach to UCD using a heuristic framework combined with consumer evaluation outputs, as a basis for app development, can successfully produce a smartphone app that is useful for knowledge retention within a well-established information campaign space on safe food management (SFM).

Fifth, the researcher also argued that the skills and attributes of individuals influence how they respond to efforts made at optimising their knowledge. Apart from consumer attributes such as age, gender, technology skills and food preparation skills, other factors that have been identified include perceived personal relevance, individual differences moderating adult learning and cognitive orientation. Therefore, it follows that food related behaviour is intimately linked to the individual's attributes, habit, knowledge and context of use. Thus, the provision of safe food management information does not necessarily result into its use, corresponding knowledge or expected behaviour.

The final chapter of this thesis highlights the conclusions of this research.

CHAPTER EIGHT

CONCLUSION

8 CONCLUSION

8.1 Introduction

The final chapter presents a summary of the research findings generated from this thesis and it discusses the contributions to knowledge this research has made. Following this, the chapter discusses the limitations of the research and provides suggestions for future research.

- Section 8.2 presents a summary of the answers to the research questions by synthesizing the five key findings to provide insights into how best to share information to facilitate knowledge retention through the use of technology in an attempt to improve the food management behaviour of Australian consumers.
- Section 8.3 summarises the research contributions made at the substantive, methodological and theoretical levels.
- Section 8.4 discusses the limitations of this research which includes the scope of research, lack of generalisability and research bias.
- Section 8.5 provides suggestions for future research.
- Section 8.6 provides a summary of this chapter.

8.2 Summarizing the Research Findings

The aim of this research was to provide insights into how best to share information to facilitate knowledge retention through the use of technology in an attempt to improve the food management behaviour of Australian consumers. This was done by investigating how the affordances of smartphone technology can be leveraged to enhance the provision of information and facilitate knowledge retention. This led to the researcher addressing the following three research questions;

Research question 1: To what extent do gaps exist in consumers' food safety knowledge?

Research Question 2: How can technology support the delivery of food safety information to consumers in a manner that facilitates better understanding?

Research Question 3: How does the use of a safe food management app influence consumer knowledge acquisition, knowledge retention and perceived behavioural change?

8.2.1 Research Question 1 – The Extent to which Food Safety Knowledge Gaps Exist in Consumers

This research has found that the sources of the food safety knowledge gaps that consumers experienced during the food recall situation investigated in this study is four-fold: industry resistance to improved information transparency; inadequate government recall response mechanism; inappropriate information modality utilised by the firm and; inappropriate information delivery channel.

Also, the investigation confirmed that consumers have sub-optimal knowledge in all the five areas investigated; safe shopping of perishable food items, safe transportation of perishable food items, safe storage of perishable food items, safe preparation of food items and appropriate kitchen hygiene practices. However, the worst problem areas, where huge knowledge gaps were identified, were preparation, kitchen hygiene practices and storage respectively.

8.2.2 Research Question 2 – Considerations for Developing a Safe Food Management App to Address Consumers' Knowledge Gaps

This research found that the design and use of food safety apps appear different from that of generic app design principles in the context of use, the need for sustainability of acquired knowledge and the consequences of poor decisions due to knowledge gaps. This led to the identification of five additional design principles that are useful to the safe food management context defined in this study, which is listed as follows;

1. **Context Appropriate Images:** This principle is concerned with the use of images that are appropriate from the perspective of food consumers, who are also the app users. Specifically, it is important that the app does not include images that can emanate polarizing views such as the image of a dismembered animal. An image may be suitable for the purpose of conveying a message to the app users but care must be taken to ensure other unintended, offensive or confusing messages are not sent to the users. Therefore, the choice of an image must be well thought-out using a broad lens to capture the diversity of perception of the intended users.

2. **Added Value:** This principle refers to the provision of other useful resources in the app, apart from its primary focus. The purpose of these resources may be for the provision of additional information, convenience to the user, context relevant support, technical support or for networking. Whilst these resources are not the primary focus of the app, they must however be relevant to the app's purpose without being overpowering. Thus, there must be a good balance.
3. **Pictures with Unilateral Purpose:** This principle involves the use of pictures that achieve a single purpose within an appropriate context. This includes ensuring that only the appropriate context is alluded to when using picture to deliver information. Pictures may pass across an educational message, a psychological message, an emotional message, other messages or a mixture of some or all of these messages. Therefore, utmost care must be taken to ensure the chosen picture in fact delivers the intended message to the users of the app.
4. **Avoidance of Sound Prompts:** This principle is concerned with the absolute avoidance of the use of sound cues or prompts when communicating information on safe food management. This is important because it is regarded as a source of distraction, thus detracting from the focus of the app. Other modalities of information such as graphics, videos, animations and little amount of texts can be used to communicate information in a more positive manner.
5. **Aesthetically pleasing:** This principle refers to the 'look and feel' of the app as it must be visually appealing and not cluttered regardless of the information modality in focus. Whilst this principle might appear generic, it however focuses on the balance required in the choice and use of multiple information modalities on the pages of the app. It is common knowledge that text-based information only is not aesthetically pleasing but this does not guarantee that other information modalities such as graphics, videos and animations are visually appealing regardless of how they are placed on the app pages. Indeed, great attention has to be given to all these information modalities in terms of features such as the layout, colours, image sizes, brightness, audio tone and the responsiveness of the design (portrait versus landscape across multiple devices) to ensure that the app design is visually appealing to the users.

It was thus revealed that technology, through a smartphone app, developed based on a modified user-centred design approach using both the generic and the specific design principles associated with safe food management, can support the delivery of food safety information to consumers in a manner that facilitates better understanding.

8.2.3 Research Question 3 - Determining the influence of the safe food management app on knowledge acquisition, knowledge retention and perceived behavioural change

This research has found that the developed safe food management (SFM) app induced a higher level of extraneous cognitive load, thus placing a level of demand on the working memory and this resulted in requiring more time to achieve knowledge acquisition. However, it also reveals that the time a learner spends in using the safe food management app containing visualizations with spoken and integrated text during the information and knowledge acquisition phase may be advantageous in facilitating knowledge retention for a longer period of time than the traditional information delivery techniques. In addition, it reveals that skills and attributes of consumers influence how they respond to a safe food management app due to their perceived personal relevance, their individual differences moderating adult learning and their orientation towards cognition.

8.3 Research Contributions

This research has made contributions to the information systems discipline by investigating how the affordances of smartphone technology can be leveraged to enhance the provision of information and facilitate knowledge retention. The contribution to knowledge is discussed in three levels; the substantive level, the methodological level and the theoretical level.

8.3.1 Substantive Level

At the substantive level, this research has contributed significantly by providing important insights in three areas: this research has uncovered the sources of food safety knowledge gaps in Australian consumers during food incidents; this research has identified the food safety knowledge gap areas requiring public health interventions in Australia; and this research revealed how the affordances of smartphones can be leveraged to enhance consumer SFM knowledge in an attempt to improve the food management behaviour of Australian consumers.

First, this research has illustrated the use of a case study approach, based on a recall incident in a food firm, to identify sources of consumer food safety knowledge gaps and apply the insight obtained into a consumer empowerment strategy. This has generated insights into the communication gaps that exist between a firm and its consumers during a food recall incident. Also, it identified factors facilitating a firm's recovery from a recall incident. These insights are particularly deemed important and rare due to the difficulty experienced when attempting to conduct a case study investigation with a food firm that had just experienced a recall, as it is difficult for firms to accommodate researchers during such a sensitive situation. The insights are indeed useful to food firms that would experience recall situations in the future as it provides recall recovery strategies.

Additionally, the research also identified food safety knowledge gap areas for consumers in Australia not only during a food incident but more broadly during normal day to day activities. These knowledge gap areas have provided a specific focus for government authorities to concentrate their efforts on public health interventions that aim to address the identified problems. Thus, this research has informed the Australian government authorities, more specifically, the food-related agencies such as Food Standards Australia New Zealand, and has made substantive contributions to public health issues requiring interventions.

Moreover, this research has demonstrated that the affordance of the safe food management app re-use for quick but infrequent revisitations facilitates knowledge retention. Therefore, it was further argued that other information channels such as TV adverts, brochures, pamphlets and other media can be useful in drawing attention to the

revisitation of such apps to reinforce and support the retention of consumer knowledge. Thus, from the public health perspective, this indicates that optimising consumers' safe food management knowledge cannot be a one-off activity as they require cues that prompt them into revising the smartphone technology-based tool so as to maintain adequate knowledge level from time to time. As such, it is recommended that the public health intervention strategies implemented by the government are continuous in order to ensure the sustainability of food safety knowledge in consumers.

8.3.2 Methodological Level

At the methodological level, this research created and used a rigorous research design process. The research was designed in such a way that the subject area was first explored in phase one (identifying knowledge gaps), to refine the research area. In addition, the research utilised an existing usability framework in phase two (design and development of the safe food management app) and conducted practical field evaluation in phase three (implementing and evaluating the safe food management app), which included a post-experiment assessment six weeks after the experiment.

Furthermore, the research employed a non-conventional software methodology by utilising a modified user centred design (UCD) approach using a heuristic framework combined with consumer evaluation outputs, as a basis for app development. Thus, this research has discovered that a smartphone app, developed based on a modified user-centred design approach using both the generic and specific design principles associated with safe food management, can support the delivery of food safety information to consumers in a manner that facilitates better understanding. Whilst such app may induce a higher level of extraneous cognitive load during the first use, which may result in requiring more time to achieve knowledge acquisition, it was revealed that this may be an advantage. This is due to the argument that the time a learner spends in using a safe food management app containing visualizations with spoken and integrated text during the information and knowledge acquisition phase may be beneficial in facilitating knowledge retention for a longer period of time than traditional information delivery techniques. Thus, the non-conventional software methodology revealed by this study

may indeed become useful to researchers that aim to create food safety related apps that facilitate learning

8.3.3 Theoretical Level

At the theoretical level, this research has contributed significantly and has provided additional principles that should be combined with Monkman and Kushniruk's (2013) health literacy online heuristics (HLOH) framework when designing a safe food management (SFM) app; thus providing design insights for Information Systems researchers that aim to develop apps that provide information on SFM.

In addition, it was revealed that skills and attributes of consumers influence how they respond to a safe food management app not only due to their age, gender and technological skills but also due to their perceived personal relevance, their individual differences moderating adult learning and their orientation towards cognition. Thus, this research revealed that food related behaviour is intimately linked to the individual's attributes, habit, knowledge and context of use. Consequently, this research has revealed that the provision of safe food management information does not necessarily result into its use, corresponding knowledge or expected behaviour. Thus, this research has provided important insights on the behavioural characteristics of food consumers for researchers aiming to develop food safety interventions.

Furthermore, having considered both the educational and social perspectives this research has revealed that, when optimising the knowledge of adult consumers, on safe food management, the mode of delivering information is important as it influences the rate at which knowledge is retained. Thus, this attests to the applicability of the principle of modality effect on educating consumers on safe food management when the information delivery tool is appropriately designed and developed. As such, this research expands upon, and enhances, the findings of Mayer (2014) that multiple modalities are effective in delivering safe food management information to influence knowledge retention when the information delivery tool is designed based on principles derived from an enhanced version of Monkman and Kushniruk's (2013) HLOH framework.

8.4 Research Limitations

Within all research methods, there are strengths and weaknesses. Therefore, it is imperative to not only acknowledge but demonstrate how these limitations have been addressed in this research. This is done by discussing the limitations of the research in terms of the scope of the research, the researcher bias and lack of generalisability.

8.4.1 Scope of Research

The sources of the knowledge gaps consumers experience during a food incident, which were identified in the first phase of the study, were based on a single case study with a food firm that experienced a recall incident in 2014. Whilst this phase was exploratory so as to provide insights into the possible communication gaps that exist between a firm and its consumers during a recall incident, more insights could have been generated if it was a multiple case study. However, this was not possible due to the difficulty in securing the participation of other firms, which had experienced a recall incident, in the study as the topic was deemed sensitive.

In addition, the research was limited by the low number of participants that participated in the experiment. Despite the active steps taken to recruit participants for a total of three months, the outcome could only produce twelve participants, out of which four of them dropped out due to family emergencies, which was a circumstance beyond the control of the researcher.

Furthermore, perceived behavioural change was measured rather than actual behavioural change due to insufficient resources (especially the limited time to PhD study completion) to support an observational method. Although the purpose of the developed app was to present safe food management information, it might be regarded as a basic app as it did not offer sophisticated technical affordances. For example; one of the technical affordances of smartphones is multimediality which includes capability for synchronous video streaming. It is possible for different app designs which incorporate more sophisticated technical affordances, such as synchronous video streaming, to have produced different and/or better results. Therefore, future studies should consider the use of synchronous video streaming as a mode of providing real time information on safe food management from trusted sources of such information (please see section 2.3.6.2 for discussion on safe food management information sources). Such studies could

conduct randomised control trials to compare the impact of providing basic information from trusted information sources (as done in this study) with real time information from similar information sources.

Also, the developed app did not undergo a heuristic evaluation but relied on a consumer-based assessment of the impact of its use. Thus, the app might still have some usability issues that have not been addressed and might need to be re-visited before it can be deployed nationwide. Nonetheless, the study has provided valuable insights into strategies for public health interventions on safe food management in the home.

8.4.2 Researcher Bias

When utilising a mixed method research approach, the strengths and weaknesses of both quantitative and qualitative methods come into play. Thus, within the context of mixed method research, the overall intent of the researcher, when discussing researcher bias, is not focused on the validity of the research but the quality of the inference (Onwuegbuzie and Johnson, 2006, Tashakkori and Teddlie, 2010). As it has been argued that inference quality should be used as the mixed research term for validity, this research has addressed the issue of researcher bias by applying Tsahakkori and Teddlie's (2010) research components of design quality and interpretive rigour to demonstrate inference quality.

Design quality refers to the standards used to evaluate the methodological rigor of the mixed research study (Onwuegbuzie and Johnson, 2006). The methodology outlined in section 3 illustrates the methodological rigor and how the design quality was achieved by demonstrating Tsahakkori and Teddlie's (2010) design suitability through the use of multiple data collection techniques and sources, which are appropriate for the research questions, throughout all the stages of the research. As the mixed method approach was sequential, the data analysis, highlighted in section 3.6, for each stage was conducted before proceeding to the subsequent stage.

Interpretive rigour is concerned with the standards for evaluating the validity of conclusions (Onwuegbuzie and Johnson, 2006). One way through which this research achieved interpretive rigour is by demonstrating Tsahakkori and Teddlie's (2010) definition of integrative efficacy as the meta-inference derived from the study and

highlighted in section 7, adequately incorporates the inferences stemming from the quantitative and qualitative phases of the study.

8.4.3 Lack of Generalisability

As argued by Tashakkori and Teddlie (2010), the term inference transferability appropriately denotes the generalisability of findings for mixed methods research. As the online survey component of this research (Advanced Stage, Phase one) was targeted at consumers within an Australian-based consumer panel database who met the inclusion criteria, the inference of the survey cannot be easily transferred to the entirety of the Australian population. Also, as the survey excluded online shoppers, the inference cannot be easily transferred to the entirety of the Australian population. However, this research may provide some insights on the food safety knowledge gap areas of consumers in Australia, which may assist in strategies for public health interventions. Also, the researcher made significant efforts to avoid a sample bias of being over representative of urban areas, heavy online users and young consumers by using a consumer panel that specifically uses a primarily offline panel recruitment policy.

In addition, in phases two and three of the research, due to the difficulty in recruiting a sample that was representative of the Australian population, participants were limited to consumers in Hobart, Tasmania; thus, the outcome of the research may be skewed. Based on this small number of participants, the findings of this study cannot be generalised to the Australian population. As such further large-scale studies would need to be conducted based on a sample that is representative of the Australian population.

Furthermore, the small number of participants might have impacted the findings of this research regarding the influence of the safe food management app on knowledge acquisition, knowledge retention and perceived behavioural change. This limitation caused by the small number of participants may lead to a possibility of potential alternative explanations for the findings which favoured the use of the app rather than the document for knowledge retention. For example; the participants in the control group (document users) might have had personal preferences for the use of electronic devices. This would have impacted upon their use of the document to facilitate knowledge acquisition. Another example is that the participants in the experimental group (app

users) might be more “technology savvy” than an average user and this might skew their perception of the app’s ease of use. Thus, this might have influenced their use of the app which could have produced results that skewed the actual impact of the app.

Also, as part of the selection criteria during participant recruitment, the participants involved were interested in cooking and therefore food safety by default, which may also skew the outcome of the research. Furthermore, in phase three of the research, confounding factors could have influenced the outcome of the study. For example; participants who have previously experienced food poisoning may be more interested in studying the app or document more than the other participants. Another example is that some participants might be more inclined to study the material (app or document) more to perform better as they knew they would be quizzed on the material. Also, in phase three of the research, it can be argued that the learner characteristics were not sufficiently built into the research design. This was due to the difficulty in predicting learner characteristics given the limited resources towards a PhD completion. Nonetheless, this research may assist in strategies for public health interventions on safe food management in the home.

8.5 Future Research

Within the Information Systems (IS) discipline, a lot of research has been conducted on public health issues in terms of child health (Knapp et al., 2011), immunisation (Heijbel and Jefferson, 2001), injury prevention (Weber et al., 2008), alcohol (Elliott et al., 2008), mental health (Luxton et al., 2011), primary health (Schoen et al., 2012), women’s health (Lev, 2009) and general health promotion (Lintonen et al., 2008). However, there has been little or no focus on food management and food safety issues from the IS perspective. This research has however provided a foundation and has opened up new areas for further research endeavours to build upon or refine its findings.

In addition, the findings of this research has revealed that food related behaviour is intimately linked to the individual’s attributes, habit, knowledge and context of use, as the provision of safe food management information does not necessarily result into its use, corresponding knowledge or expected behaviour. These insights have provided an opportunity for researchers to incorporate these findings into the development of tools that transits beyond knowledge optimisation and achieves corresponding change in

consumer safe food management behaviour as observed by the researchers. Thus, other types of app designs using varying depths of transmission approaches, interactive approaches and gamification approaches might be useful to achieve this.

Whilst it has been argued by Moreno and Mayer (2005), that the principle of modality effect can indeed reduce extraneous cognitive load for technology-based tools developed on mobile devices, this study incorporated the principle by designing and developing a safe food management app based on an enhanced version of Monkman and Kushniruk's HLOH framework. Yet, the findings indicate that some level of cognitive load was still induced. Although the evidence is lacking, it appears to this researcher that the HLOH framework seem to have minimized the cognitive burden to a certain extent. As such, future studies should investigate the extent to which this principle, when combined with the enhanced version of the HLOH framework, reduces extraneous cognitive load on smartphone apps designed for safe food management knowledge optimisation.

Additionally, this research has revealed that post-purchase domestic food handling and management may well be a medium to high involvement task for consumers with a lower level of knowledge on safe food management. However, existing research has largely focused on consumer understanding of food safety information, from the pre-purchase perspective which is a low involvement task (van Trijp, 2009, Insch and Jackson, 2013). Thus, this research has uncovered a gap in our knowledge on consumer knowledge optimisation and the corresponding translation into safe food management behaviour; and thus argues for further research into consumer level of task involvement in relation to the depth of consumer knowledge on safe food management.

Furthermore, the survey conducted in this research should be carried out on a much broader scale to ensure it is representative of the Australian population. Also, the experiment conducted in this research should be done with many more participants from all the states and territories within Australia, not just Tasmania. In addition, the experiment will benefit from participant observation when investigating behavioural changes in consumers. This will contribute towards a holistic solution to the domestic safe food management issues in Australia.

8.6 Thesis Summary

This research began by investigating the extent to which food safety knowledge gaps exist in consumers and to identify specific problem areas in domestic safe food management. Insights derived from this led to the need to empower consumers to optimise their safe food management knowledge which led to the design and development of a safe food management smartphone app. Best practice guidelines were retrieved from government agencies which were incorporated in the app. In addition, the smartphone app was designed after generating insights from a selection of existing apps that address the most disturbing food safety knowledge gap areas that had been identified in the preceding phase. The research design incorporated a combined heuristic and consumer based evaluation to uncover the issues and benefits associated with the existing apps. This provided in-depth understanding into the uniqueness of the safe food management context as specific design principles which should be combined with the generic app design principles were discovered and incorporated into the app design. Following this, the app was implemented and evaluated to determine if it could indeed empower consumers to facilitate knowledge acquisition, knowledge retention and capacity for behavioural change towards domestic safe food management.

Thus, the overarching aim of the research was achieved by investigating how best to share information to facilitate knowledge retention through the use of technology in an attempt to improve the food management behaviour of Australian consumers. This was done by investigating how the affordances of smartphone technology can be leveraged to enhance the provision of information and facilitate knowledge retention.

This research found that multiple modalities are effective in delivering safe food management information to influence knowledge retention when the information delivery tool is designed based on principles derived from an enhanced version of Monkman and Kushniruk's (2013) HLOH framework. Furthermore, it was discovered that the developed safe food management (SFM) app requires more time to be spent to achieve knowledge acquisition which resulted in retaining the knowledge for a longer period of time than traditional information delivery techniques. Moreover, whilst smartphone apps induce some level of cognitive load in adoption, there is evidence to suggest that the affordance of its reuse for quick but infrequent revisitations facilitates knowledge retention. Also, it was revealed that the use of a modified user centred design approach, using a heuristic framework with consumer evaluation outputs as a basis for

app development, can support the development of a safe food management app. Finally, it was revealed that food related behaviour is intimately linked to the individual's attributes, habit, knowledge and context of use as the provision of safe food management information does not necessarily result into its use, corresponding knowledge or expected behaviour.

This research has made a number of contributions at substantive, methodological and theoretical levels. At a substantive level, this research has contributed significantly by providing insights in three areas: how the affordances of smartphones can be leveraged to enhance consumer SFM knowledge in an attempt to improve the food management behaviour of Australian consumers; sources of food safety knowledge gaps in consumers during food incidents; and food safety knowledge gap areas requiring public health interventions. At the methodological level, this research was designed in such a way that the subject area was first explored in phase one, to refine the research area. In addition, the research tested an existing usability framework in phase two and conducted practical field evaluation in phase three. Furthermore, the research employed a non-conventional software methodology by utilising a modified user centred design (UCD) approach using a heuristic framework combined with consumer evaluation outputs, as a basis for app development. At the theoretical level, this research has contributed significantly and has provided insight into additional principles that should be combined with Monkman and Kushniruk's (2013) HLOH framework when designing a SFM app; thus providing design insights for Information Systems researchers that aim to develop apps that provide information on SFM.

This research has however provided a foundation and has opened up new areas for further research endeavours to build upon or refine its findings; in a bid to extend research endeavours between food safety and the information systems domain.

9 REFERENCES

- ABRAS, C., MALONEY-KRICHMAR, D. & PREECE, J. 2004. User-centered design. *Bainbridge, W. Encyclopedia of Human-Computer Interaction. Thousand Oaks: Sage Publications*, 37, 445-456.
- ABS 2014. Household Use of Information Technology, Australia, 2012-13 - Report 8146.0. *In: STATISTICS*, A. B. O. (ed.).
- ACCC 2014. Product and Safety Recalls Australia - Dairy and Eggs. *In: COMMISSION*, A. C. A. C. (ed.).
- ACHARYA, R. N., KAGAN, A. & MANFREDO, M. R. 2009. Impact of rising fuel cost on perishable product procurement. *Journal of Business Logistics*, 30, 223-242.
- ACHERBERG, P. 2014. Knowing hydrogen and loving it too? Information provision, cultural predispositions, and support for hydrogen technology among the Dutch. *Public Understanding of Science*, 23, 445-453.
- ACTON, T. & GOLDEN, W. 2003. Training the knowledge worker: a descriptive study of training practices in Irish software companies. *Journal of European Industrial Training*, 27, 137-146.
- AHLE, S., KRAPF, J., BROWN, K. M., LEE, J., BUTERA, G., GOLDMAN, E., FERZLI, M. & JURJUS, R. A. 2014. Improving Anatomical Knowledge Retention in Medical Students Entering the Surgery and Obstetrics and Gynecology Clinical Rotations by Nesting Interactive Modules.
- AHMED, S. & PARSONS, D. 2013. Abductive science inquiry using mobile devices in the classroom. *Computers & Education*, 63, 62-72.
- AIHW 2011. Health and the environment: a compilation of evidence. *In: WELFARE*, A. I. O. H. A. (ed.). Canberra: AIHW.
- AIZAKI, H., SAWADA, M. & SATO, K. 2011. Consumers' attitudes toward consumption of cloned beef. The impact of exposure to technological information about animal cloning. *Appetite*, 57, 459-466.
- AL-SAKKAF, A. 2012. Evaluation of food handling practice among New Zealanders and other developed countries as a main risk factor for campylobacteriosis rate. *Food Control*, 27, 330-337.
- AL-UBAYDLI, O. & LIST, J. A. 2015. Do Natural Field Experiments Afford Researchers More or Less Control than Laboratory Experiments? A Simple Model. National Bureau of Economic Research.
- ANDERSON, L. W., KRATHWOHL, D. R. & BLOOM, B. S. 2001. *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives*, Allyn & Bacon.
- ANGERS, J. & MACHTMES, K. 2005. An ethnographic-case study of beliefs, context factors, and practices of teachers integrating technology. *The Qualitative Report*, 10, 771-794.
- ANZFA 2001. Safe Food Australia - A Guide to the Food Safety Standards. *In: FOOD SAFETY PROGRAM*, A. N. Z. F. A. (ed.) 2nd ed. Canberra, Australia: Australia New Zealand Food Authority.
- APPLE. 2018. *Ratings, Reviews, and Responses* [Online]. Available: <https://developer.apple.com/app-store/ratings-and-reviews/> [Accessed 14/02/2018].
- ASHTON-HAY, S. 2005. Drama: Engaging all learning styles.

- ASKEGAARD, S. R. & BRUNSON, K. 1999. Food-related life styles in Singapore: Preliminary testing of a Western European research instrument in Southeast Asia. *Journal of Euromarketing*, 7, 65-86.
- ATKINSON, P. & COFFEY, A. 1997. Analysing Documentary Realities Qualitative Research Theory, Method and Practice. London: Sage.
- ATTRIDE-STIRLING, J. 2001. Thematic networks: an analytic tool for qualitative research. *Qualitative research*, 1, 385-405.
- AUGER, P., DEVINNEY, T. M. & LOUVIERE, J. J. 2007. Using best-worst scaling methodology to investigate consumer ethical beliefs across countries. *Journal of business ethics*, 70, 299-326.
- AUNG, M. M. & CHANG, Y. S. 2014. Traceability in a food supply chain: Safety and quality perspectives. *Food Control*, 39, 172-184.
- AUSUBEL, D. P. 2012. *The acquisition and retention of knowledge: A cognitive view*, Springer Science & Business Media.
- AYRES, P. & CIERNIAK, G. 2012. Split-Attention Effect. *Encyclopedia of the Sciences of Learning*. Springer.
- AYRES, P. & PAAS, F. 2012. Cognitive load theory: New directions and challenges. *Applied Cognitive Psychology*, 26, 827-832.
- AZIZ, A. A., SULEIMAN, N. S. & ZAHARI, A. S. M. 2016. A Study on the Effectiveness of Multimedia Instructional Materials for Adult Learners. *J. Appl. Environ. Biol. Sci*, 6, 47-56.
- AZZOPARDI, E. & NASH, R. 2014. An Examination of Philosophical Paradigms and a Rational for Adopting a Mixed Methods Approach. *Tourism Analysis*, 19, 151-159.
- BAGGETT, P. 1979. Structurally equivalent stories in movie and text and the effect of the medium on recall. *Journal of Verbal Learning and Verbal Behavior*, 18, 333-356.
- BÄHLER, A. 2015. *Smart Recipes*. Master, Swiss Federal Institute of Technology, Zurich.
- BAI, L., TANG, J., YANG, Y. & GONG, S. 2014. Hygienic food handling intention. An application of the Theory of Planned Behavior in the Chinese cultural context. *Food Control*, 42, 172-180.
- BAIRI, J., MURALI MANOHAR, B. & KUNDU, G. K. 2011. Knowledge retention in the IT service industry. *Journal of Systems and Information Technology*, 13, 43-65.
- BALEMANS, M., KOOLOOS, J. G., DONDEERS, A. R. T., DER ZEE, V. & CATHARINA, E. 2016. Actual drawing of histological images improves knowledge retention. *Anatomical sciences education*, 9, 60-70.
- BAMGBOJE-AYODELE, A., ELLIS, L. & TURNER, P. 2015. Supporting 'Good Habits' through User-Led Design of Food Safety Applications - Findings from a Survey of Red Meat Consumers. *Australasian Conference on Information Systems*. South Australia.
- BAMGBOJE-AYODELE, A., ELLIS, L. & TURNER, P. 2016. A Food Recall Case Study in Australia – Towards the Development of Food Safety Applications for Consumers. *International Journal of Food Studies*, 5.
- BANDERA, C., PASSERINI, K., PON, K. & EMINET, A. A Mind Map Comparison of Knowledge Retention between French and United States University Entrepreneurship Education. United States Association for Small Business and

- Entrepreneurship. Conference Proceedings, 2016. United States Association for Small Business and Entrepreneurship, JD1.
- BARKHORDAR, A., POLLARD, D. & HOBKIRK, J. 2000. A comparison of written and multimedia material for informing patients about dental implants. *Dental update*, 27, 80.
- BAUMGARTNER, H. & STEENKAMP, J.-B. E. 2001. Response styles in marketing research: A cross-national investigation. *Journal of Marketing Research*, 38, 143-156.
- BEARTH, A., COUSIN, M.-E. & SIEGRIST, M. 2014a. Investigating novice cooks' behaviour change: Avoiding cross-contamination. *Food Control*, 40, 26-31.
- BEARTH, A., COUSIN, M.-E. & SIEGRIST, M. 2014b. Poultry consumers' behaviour, risk perception and knowledge related to campylobacteriosis and domestic food safety. *Food Control*, 44, 166-176.
- BECHINI, A., CIMINO, M. G., LAZZERINI, B., MARCELLONI, F. & TOMASI, A. A general framework for food traceability. Applications and the Internet Workshops, 2005. Saint Workshops 2005. The 2005 Symposium on, 2005. IEEE, 366-369.
- BEETHAM, H. & SHARPE, R. 2013. *Rethinking pedagogy for a digital age: Designing for 21st century learning*, routledge.
- BEHRENS, J. H., BARCELLOS, M. N., FREWER, L. J., NUNES, T. P., FRANCO, B. D. G. M., DESTRO, M. T. & LANDGRAF, M. 2010. Consumer purchase habits and views on food safety: A Brazilian study. *Food Control*, 21, 963-969.
- BELCH, G. E. 1982. The effects of television commercial repetition on cognitive response and message acceptance. *Journal of consumer research*.
- BENBASAT, I., GOLDSTEIN, D. K. & MEAD, M. 1987. The Case Research Strategy in Studies of Information Systems. *MIS quarterly*, 11, 369-386.
- BERG, B. L. & LUNE, H. 2004. *Qualitative research methods for the social sciences*, Pearson Boston.
- BERNARD, H. H. R. & RYAN, G. W. 2009. *Analyzing qualitative data: Systematic approaches*, SAGE publications.
- BERNHARDT, J. M. 2004. Communication at the core of effective public health. American Public Health Association.
- BESLER, H. T., BUYUKTUNCER, Z. & UYAR, M. F. 2012. Consumer Understanding and Use of Food and Nutrition Labeling in Turkey. *Journal of Nutrition Education and Behavior*, 44, 584-591.
- BEULENS, A. J. M., BROENS, D.-F., FOLSTAR, P. & HOFSTEDE, G. J. 2005. Food safety and transparency in food chains and networks Relationships and challenges. *Food Control*, 16, 481-486.
- BIRAN, A., SCHMIDT, W.-P., VARADHARAJAN, K. S., RAJARAMAN, D., KUMAR, R., GREENLAND, K., GOPALAN, B., AUNGER, R. & CURTIS, V. 2014. Effect of a behaviour-change intervention on handwashing with soap in India (SuperAmma): a cluster-randomised trial. *The Lancet Global Health*, 2, e145-e154.
- BLAKE, C. E., DEVINE, C. M., WETHINGTON, E., JASTRAN, M., FARRELL, T. J. & BISOGNI, C. A. 2009. Employed parents' satisfaction with food-choice coping strategies. Influence of gender and structure. *Appetite*, 52, 711-719.
- BLANCO, C. F., SARASA, R. G. & SANCLEMENTE, C. O. 2010. Effects of visual and textual information in online product presentations: looking for the best

- combination in website design. *European Journal of information systems*, 19, 668-686.
- BLANKENSHIP, L., BRUECK, T., RETTIE, M., BERRY, D. & LEE, J. 2009. Strategies to Help Drinking Water Utilities Ensure Effective Retention of Knowledge.
- BOASE, J. 2008. Personal networks and the personal communication system: Using multiple media to connect. *Information, communication & society*, 11, 490-508.
- BÖHMER, M., HECHT, B., SCHÖNING, J., KRÜGER, A. & BAUER, G. Falling asleep with Angry Birds, Facebook and Kindle: a large scale study on mobile application usage. Proceedings of the 13th international conference on Human computer interaction with mobile devices and services, 2011. ACM, 47-56.
- BOLAND, R. J., TENKASI, R. V. & TE'ENI, D. 1994. Designing information technology to support distributed cognition. *Organization Science*, 5, 456-475.
- BONDARIANZADEH, D., YEATMAN, H. & CONDON-PAOLONI, D. 2011. A qualitative study of the Australian midwives' approaches to Listeria education as a food-related risk during pregnancy. *Midwifery*, 27, 221-228.
- BORNSTEIN, R. F. 1989. Exposure and affect: Overview and meta-analysis of research, 1968–1987. *Psychological bulletin*, 106, 265.
- BOSONA, T. & GEBRESENBET, G. 2013. Food traceability as an integral part of logistics management in food and agricultural supply chain. *Food Control*, 33, 32-48.
- BOUTHILLIER, F. & SHEARER, K. 2002. Understanding knowledge management and information management: the need for an empirical perspective. *Information Research*, 8, 8-1.
- BOWEN, G. A. 2009. Document analysis as a qualitative research method. *Qualitative research journal*, 9, 27-40.
- BOYATZIS, R. E. 1998. *Transforming qualitative information: Thematic analysis and code development*, Sage.
- BRAUN, V. & CLARKE, V. 2006. Using thematic analysis in psychology. *Qualitative research in psychology*, 3, 77-101.
- BRAY, R. M., KERR, N. L. & ATKIN, R. S. 1978. Effects of group size, problem difficulty, and sex on group performance and member reactions. *Journal of Personality and Social Psychology*, 36, 1224.
- BRENNAN, M., MCCARTHY, M. & RITSON, C. 2007. Why do consumers deviate from best microbiological food safety advice? An examination of 'high-risk' consumers on the island of Ireland. *Appetite*, 49, 405-418.
- BROUDY, H. S. 1964. *Democracy and excellence in American secondary education: A study in curriculum theory*, Rand McNally.
- BROWN, B. & GREEN, N. 2012. *Wireless world: Social and interactional aspects of the mobile age*, Springer Science & Business Media.
- BROWN, B., REEVES, S. & SHERWOOD, S. Into the wild: challenges and opportunities for field trial methods. Proceedings of the SIGCHI conference on human factors in computing systems, 2011. ACM, 1657-1666.
- BRUNKEN, R., PLASS, J. L. & LEUTNER, D. 2003. Direct measurement of cognitive load in multimedia learning. *Educational Psychologist*, 38, 53-61.
- BRÜNKEN, R., PLASS, J. L. & LEUTNER, D. 2004. Assessment of cognitive load in multimedia learning with dual-task methodology: Auditory load and modality effects. *Instructional Science*, 32, 115-132.

- BRUNSDØ, K., FJORD, T. A. & GRUNERT, K. G. 2002. *Consumers' food choice and quality perception*, Aarhus School of Business, MAPP-Centre for Research on Customer Relations in the Food Sector.
- BUGAISKA, A., CLARYS, D., JARRY, C., TACONNAT, L., TAPIA, G., VANNESTE, S. & ISINGRINI, M. 2007. The effect of aging in recollective experience: The processing speed and executive functioning hypothesis. *Consciousness and cognition*, 16, 797-808.
- BURRELL, G. & MORGAN, G. 1979. *Sociological paradigms and organisational analysis*, London: Heinemann.
- BUYS, C. J. & LARSON, K. L. 1979. Human sympathy groups. *Psychological reports*, 45, 547-553.
- BYRD-BREDBENNER, C., MAURER, J., WHEATLEY, V., SCHAFFNER, D., BRUHN, C. & BLALOCK, L. 2007. Food safety self-reported behaviors and cognitions of young adults: results of a national study. *Journal of Food Protection*, 70, 1917-1926.
- CAC 2003a. Basic texts on food hygiene. In: COMMISSION, C. A. (ed.) 3rd ed. Rome.
- CAC. 2003b. Definitions for the Purposes of the Codex Alimentarius *Codex Alimentarius Commission - Procedural Manual* [Online]. Available: <http://www.fao.org/docrep/007/y5817e/y5817e02.htm#bm02.6> [Accessed 19th November 2011].
- CAFAZZO, J. A., CASSELMAN, M., HAMMING, N., KATZMAN, D. K. & PALMERT, M. R. 2012. Design of an mHealth App for the Self-management of Adolescent Type 1 Diabetes: A Pilot Study. *J Med Internet Res*, 14, e70.
- CAIRNS, P. & COX, A. L. 2008. *Research methods for human-computer interaction*, Cambridge University Press.
- CAMARA, S. & ABDELNOUR-NOCERA, J. 2013. Revealing the Socio-Technical Context of Design Settings: Toward Participatory IS Design. *International Journal of Human-Computer Interaction*, 29, 289-307.
- CANNUSCIO, C. C., HILLIER, A., KARPYN, A. & GLANZ, K. 2014. The social dynamics of healthy food shopping and store choice in an urban environment. *Social Science & Medicine*, 122, 13-20.
- CARD, K., MORRAN, T. & NEWELL, A. 1983. The psychology of human-computer interaction. *Lawrence Erlbaum Associates*.
- CARDELLO, A. V. 1995. Food quality: relativity, context and consumer expectations. *Food Quality and Preference*, 6, 163-170.
- CARMINES, E. G. & ZELLER, R. A. 1979. *Reliability and validity assessment*, Sage.
- CAROLINE MARTINS, E. & MEYER, H. W. 2012. Organizational and behavioral factors that influence knowledge retention. *Journal of Knowledge Management*, 16, 77-96.
- CASTELLS, M. 2011. *The rise of the network society: The information age: Economy, society, and culture*, John Wiley & Sons.
- CDC 2011. Estimating Foodborne Illness: An Overview. In: PREVENTION, C. F. D. C. A. (ed.). Atlanta, USA.
- CEPEDA, N. J., COBURN, N., ROHRER, D., WIXTED, J. T., MOZER, M. C. & PASHLER, H. 2009. Optimizing distributed practice: Theoretical analysis and practical implications. *Experimental psychology*, 56, 236-246.
- CHANDLER, P. & SWELLER, J. 1992. The Split-Attention Effect as a Factor in the Design of Instruction. *British Journal of Educational Psychology*, 62, 233-246.

- CHANG, S. E. & PAN, Y.-H. V. 2011. Exploring factors influencing mobile users' intention to adopt multimedia messaging service. *Behaviour & Information Technology*, 30, 659-672.
- CHARMAZ, K. 2006. *Constructing grounded theory: A practical guide through qualitative analysis*, Pine Forge Press.
- CHEONG, S., KAUR, J., LIM, K., HO, B. & MOHMAD, S. 2013. Use and understanding of nutrition labeling among elderly men and women in Malaysia. *Malaysian Journal of Nutrition*, 19, 353-362.
- CHIANG, T. H., YANG, S. J. & HWANG, G.-J. 2014. An Augmented Reality-based Mobile Learning System to Improve Students' Learning Achievements and Motivations in Natural Science Inquiry Activities. *Educational Technology & Society*, 17, 352-365.
- CHIOU, C.-K., TSENG, J. C., HWANG, G.-J. & HELLER, S. 2010. An adaptive navigation support system for conducting context-aware ubiquitous learning in museums. *Computers & Education*, 55, 834-845.
- CHO, J.-H., KIM, S.-B., KIM, S.-K., KIM, M.-H., KIM, G.-S., KIM, S.-N., KIM, S.-Y. & KIM, J.-W. 2013. Development of children's food avatar application for dietary education. *Korean Journal of Community Nutrition*, 18, 299-311.
- CHOO, C. W. 2002. *Information management for the intelligent organization: the art of scanning the environment*, Information Today, Inc.
- CHU, H.-C., HWANG, G.-J. & TSAI, C.-C. 2010. A knowledge engineering approach to developing mindtools for context-aware ubiquitous learning. *Computers & Education*, 54, 289-297.
- CIERNIAK, G., SCHEITER, K. & GERJETS, P. 2009. Explaining the split-attention effect: Is the reduction of extraneous cognitive load accompanied by an increase in germane cognitive load? *Computers in Human Behavior*, 25, 315-324.
- CLARK, B. 2014. A Study Of The Effects On Retention Of Different Time Intervals Between Opportunities To Learn.
- CLEAR, A. K., FRIDAY, A. J., ROUNCEFIELD, M. F. & CHAMBERLAIN, A. 2015. Supporting sustainable food shopping. *IEEE pervasive computing*, 14, 28-36.
- COHEN, S. Maximum difference scaling: improved measures of importance and preference for segmentation. Sawtooth Software Conference Proceedings, Sawtooth Software, Inc, 2003. 61-74.
- COHEN, S. & ORME, B. 2004. What's your preference? *Marketing Research*, 16, 32-37.
- COOK, D. J. & DAS, S. K. 2007. How smart are our environments? An updated look at the state of the art. *Pervasive and mobile computing*, 3, 53-73.
- COOK, S. D. & BROWN, J. S. 1999. Bridging epistemologies: The generative dance between organizational knowledge and organizational knowing. *Organization Science*, 10, 381-400.
- COOK, T. D., CAMPBELL, D. T. & SHADISH, W. 2002. *Experimental and quasi-experimental designs for generalized causal inference*, Houghton Mifflin Boston.
- COPE, S., FREWER, L. J., HOUGHTON, J., ROWE, G., FISCHER, A. R. H. & DE JONGE, J. 2010a. Consumer perceptions of best practice in food risk communication and management: Implications for risk analysis policy. *Food Policy*, 35, 349-357.
- COPE, S., FREWER, L. J., RENN, O. & DREYER, M. 2010b. Potential methods and approaches to assess social impacts associated with food safety issues. *Food Control*, 21, 1629-1637.

- CORBIN, J. M. & STRAUSS, A. 1990. Grounded theory research: Procedures, canons, and evaluative criteria. *Qualitative sociology*, 13, 3-21.
- COYNE, R. 2010. *The tuning of place*, MIT press.
- CRESWELL, J., TASHAKKORI, A., JENSEN, K. & SHAPLEY, K. 2003. Teaching mixed methods research: Practices, dilemmas, and challenges. *Handbook of mixed methods in social and behavioral research*, 619-637.
- CRESWELL, J. W. & CLARK, V. L. P. 2007. Designing and conducting mixed methods research.
- CRONIN, B. Disjointed incrementalism and 1990. Aslib proceedings, 1985. MCB UP Ltd, 421-436.
- CROSS, D. I. 2009. Alignment, cohesion, and change: Examining mathematics teachers' belief structures and their influence on instructional practices. *Journal of Mathematics Teacher Education*, 12, 325-346.
- CRYSTAL, D. 2007. *How language works*, Penguin UK.
- CUEVAS, H. M. 2004. An Illustrative Example of Four HCI Design Approaches for Evaluating an Automated System Interface. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, 48, 892-896.
- CUMMINS, S., FLINT, E. & MATTHEWS, S. A. 2014. New neighborhood grocery store increased awareness of food access but did not alter dietary habits or obesity. *Health Affairs*, 33, 283-291.
- D'SOUZA, G. & RAO, R. C. 1995. Can repeating an advertisement more frequently than the competition affect brand preference in. *Journal of Marketing*, 59.
- DABBAGH, N. & REO, R. 2011. Tracing the Roots and Learning Affordances of Social Software. *Web 2.0-Based E-Learning: Applying Social Informatics for*, 1.
- DAVENPORT, T. H. & PRUSAK, L. 2000. *Working knowledge: How organizations manage what they know*, Harvard Business Press.
- DE BACKER, C. J. & HUDDERS, L. 2015. Meat morals: relationship between meat consumption consumer attitudes towards human and animal welfare and moral behavior. *Meat science*, 99, 68-74.
- DE JONGE, J., VAN TRIJP, H., JAN RENES, R. & FREWER, L. 2007. Understanding Consumer Confidence in the Safety of Food: Its Two-Dimensional Structure and Determinants. *Risk analysis*, 27, 729-740.
- DE KROM, M. P. M. M. & MOL, A. P. J. 2010. Food risks and consumer trust. Avian influenza and the knowing and non-knowing on UK shopping floors. *Appetite*, 55, 671-678.
- DE SOUZA, A. E. & FRITH, J. 2012. *Mobile interfaces in public spaces: Locational privacy, control, and urban sociability*, Routledge.
- DE SOUZA E SILVA, A. & FRITH, J. 2010. Locative mobile social networks: Mapping communication and location in urban spaces. *Mobilities*, 5, 485-505.
- DE VITO, K. M. 2010. Implementing adult learning principles to overcome barriers of learning in continuing higher education programs. *Online Journal for Workforce Education and Development*, 3, 1.
- DEEKS, J. J., DINNES, J., D'AMICO, R., SOWDEN, A., SAKAROVITCH, C., SONG, F., PETTICREW, M. & ALTMAN, D. 2003. Evaluating non-randomised intervention studies. *Health technology assessment (Winchester, England)*, 7, iii-x, 1-173.
- DEERING, M. J. & HARRIS, J. 1996. Consumer health information demand and delivery: implications for libraries. *Bulletin of the Medical Library Association*, 84, 209.

- DEKHANE, S. & TSOI, M. Y. 2012. Designing a mobile application for conceptual understanding: integrating learning theory with organic chemistry learning needs. *International Journal of Mobile and Blended Learning (IJMBL)*, 4, 34-52.
- DELANEY, P. F., VERKOEIJEN, P. P. & SPIRGEL, A. 2010. Spacing and testing effects: A deeply critical, lengthy, and at times discursive review of the literature. *Psychology of learning and motivation*, 53, 63-147.
- DELEEUW, K. E. & MAYER, R. E. 2008. A comparison of three measures of cognitive load: Evidence for separable measures of intrinsic, extraneous, and germane load. *Journal of Educational Psychology*, 100, 223.
- DESPORTES, J.-P. & LEMAINÉ, J.-M. 1988. The sizes of human groups: An analysis of their distributions. *Environmental social psychology*. Springer.
- DEY, I. 2003. *Qualitative data analysis: A user friendly guide for social scientists*, Routledge.
- DHAROD, J. M., PÉREZ-ESCAMILLA, R., BERMÚDEZ-MILLÁN, A., SEGURA-PÉREZ, S. & DAMIO, G. 2004. Influence of the Fight BAC! food safety campaign on an urban Latino population in Connecticut. *Journal of Nutrition Education and Behavior*, 36, 128-134.
- DHHS 2007. Usability. gov: Your guide for developing usable and useful Web sites. . US Department of Health Human Services.
- DHHS 2010. Health literacy online: A guide to writing and designing easy-to-use health Web sites. In: PROMOTION, O. O. D. P. H. (ed.). Washington DC.
- DIAMOND, J. & DIAMOND, E. 2008. *The world of fashion*, Fairchild Books.
- DIAZ, A. L. 2003. Personal, family, and academic factors affecting low achievement in secondary school. *Electronic journal of research in educational psychology and psychopedagogy*, 1, 43-66.
- DIJKSTRA, A. & BALLAST, K. 2012. Personalization and perceived personal relevance in computer-tailored persuasion in smoking cessation. *British journal of health psychology*, 17, 60-73.
- DOGAN, H., HENSHAW, M. J. D. C. & RAGSDELL, G. 2011. The Risk of Information Management Without Knowledge Management: A Case Study. *Journal of Information & Knowledge Management*, 10, 393-408.
- DONELAN, A. K., CHAMBERS, D. H., CHAMBERS IV, E., GODWIN, S. L. & CATES, S. C. 2016. Consumer poultry handling behavior in the grocery store and in-home storage. *Journal of food protection*, 79, 582-588.
- DOS SANTOS NUNES, E. P., ROQUE, L. G. & DOS SANTOS NUNES, F. D. L. 2016. Measuring Knowledge Acquisition in 3D Virtual Learning Environments. *IEEE computer graphics and applications*, 36, 58-67.
- DRUCKER, P. F. 2007. *Management challenges for the twenty-first century*, Routledge.
- DRUMM, J. & SWIEGERS, M. 2015. Mobile Consumer Survey 2015 - The Australian Cut: Life's Smarter than you think. Australia: Deloitte
- DUAN, L., KUBO, T., SUGIYAMA, K., HUANG, J., HASEGAWA, T. & WALRAND, J. 2014. Motivating smartphone collaboration in data acquisition and distributed computing. *IEEE Transactions on Mobile Computing*, 13, 2320-2333.
- DUBOWITZ, T., GHOSH-DASTIDAR, M., COHEN, D. A., BECKMAN, R., STEINER, E. D., HUNTER, G. P., FLÓREZ, K. R., HUANG, C., VAUGHAN, C. A. & SLOAN, J. C. 2015. Diet and perceptions change with supermarket introduction in a food desert, but not because of supermarket use. *Health Affairs*, 34, 1858-1868.

- DUNNING, D. 2011. 5 The Dunning-Kruger Effect: On Being Ignorant of One's Own Ignorance. *Advances in experimental social psychology*, 44, 247.
- DURANT, D. 2002. Take a look at real magic: Disney and food safety. *The Food Safety Educator*, 7.
- EBERTS, R. E. 1994. *User interface design*, Prentice-Hall, Inc.
- EFSA 2012. The European Union Summary Report on Trends and Sources of Zoonoses, Zoonotic Agents and Food-borne Outbreaks in 2010. *EFSA Journal*, 10, 2597.
- EHRLINGER, J., JOHNSON, K., BANNER, M., DUNNING, D. & KRUGER, J. 2008. Why the unskilled are unaware: Further explorations of (absent) self-insight among the incompetent. *Organizational behavior and human decision processes*, 105, 98-121.
- ELINA JAAKKOLA, A. H., DR LEENA AARIKKA-STENROOS, D., DUBE, A. & HELKKULA, A. 2015. Service experiences beyond the direct use: indirect customer use experiences of smartphone apps. *Journal of Service Management*, 26, 224-248.
- ELLIOTT, J. C., CAREY, K. B. & BOLLES, J. R. 2008. Computer-based interventions for college drinking: a qualitative review. *Addictive behaviors*, 33, 994-1005.
- EMERSON, R., FRETZ, R. I. & SHAW, L. 1995. *Writing field notes*. Chicago, IL: University of Chicago Press.
- ERDEM, S., RIGBY, D. & WOSSINK, A. 2012. Using best–worst scaling to explore perceptions of relative responsibility for ensuring food safety. *Food Policy*, 37, 661-670.
- ERGÖNÜL, B. 2013. Consumer awareness and perception to food safety: A consumer analysis. *Food Control*, 32, 461-471.
- ESTABROOKS, C. A., THOMPSON, D. S., LOVELY, J. J. E. & HOFMEYER, A. 2006. A guide to knowledge translation theory. *Journal of Continuing Education in the Health Professions*, 26, 25-36.
- FAGEEH, A. 2011. At Crossroads of EFL Learning and Culture: How to Enhance Cross-cultural Awareness in EFL College Students. *Cross-Cultural Communication*, 7, 62.
- FAIKS, A. & HYLAND, N. 2000. Gaining user insight: a case study illustrating the card sort technique. *College & research libraries*, 61, 349-357.
- FAO. 1999. Elements and Guiding Principles of Risk Communication. *The application of risk communication to food standards and safety matters* [Online]. Available: <http://www.fao.org/docrep/005/x1271e/X1271E03.htm#ch3.2> [Accessed 19th November 2011].
- FAO. 2001. Manual on the application of the HACCP system in mycotoxin prevention and control. *FAO Food and Nutrition Paper 73* [Online]. Available: <ftp://ftp.fao.org/docrep/fao/005/y1390e/y1390e00.pdf> [Accessed 6th July 2016].
- FARR-WHARTON, G., CHOI, J. H.-J. & FOTH, M. Food talks back: exploring the role of mobile applications in reducing domestic food wastage. Proceedings of the 26th Australian Computer-Human Interaction Conference on Designing Futures: the Future of Design, 2014. ACM, 352-361.
- FDA 1994. Food Safety Assurance Program: Development of Hazard Analysis Critical Control Points: Proposed Rule. *Federal Register*, 59-149.
- FEILZER, M. Y. 2010. Doing mixed methods research pragmatically: Implications for the rediscovery of pragmatism as a research paradigm. *Journal of mixed methods research*, 4, 6-16.

- FERNBACH, P. M., ROGERS, T., FOX, C. R. & SLOMAN, S. A. 2013. Political extremism is supported by an illusion of understanding. *Psychological science*, 0956797612464058.
- FERREIRA, D., GONCALVES, J., KOSTAKOS, V., BARKHUUS, L. & DEY, A. K. Contextual experience sampling of mobile application micro-usage. Proceedings of the 16th international conference on Human-computer interaction with mobile devices & services, 2014. ACM, 91-100.
- FINKEL, D., REYNOLDS, C. A., MCARDLE, J. J. & PEDERSEN, N. L. 2007. Age changes in processing speed as a leading indicator of cognitive aging. *Psychology and aging*, 22, 558.
- FINN, A. & LOUVIERE, J. J. 1992. Determining the appropriate response to evidence of public concern: the case of food safety. *Journal of Public Policy & Marketing*, 11, 12-25.
- FISHER, M. & C KEIL, F. 2015. The curse of expertise: When more knowledge leads to miscalibrated explanatory insight. *Cognitive Science*.
- FLEURY, A., PEDERSEN, J. S. & LARSEN, L. B. A Pragmatic Approach to Testing Issues in a Mobile Platform that Does Not Yet Exist. In: PENG, C., VUORIMAA, P., NÄRÄNEN, P., QUICO, C., HARBOE, G. & LUGMAYR, A., eds. Adjunct Proceedings EuroITV 2010, 2010 Tampere University of Technology, Finland. Tampere, Finland., 262-263.
- FLING, B. 2009. *Mobile design and development: Practical concepts and techniques for creating mobile sites and Web apps*, " O'Reilly Media, Inc."
- FREDRIKSSON, A. & LILJESTRAND, K. 2015. Capturing food logistics: a literature review and research agenda. *International Journal of Logistics Research and Applications*, 18, 16-34.
- FREWER, L. 2000. Risk perception and risk communication about food safety issues. *Nutrition Bulletin*, 25, 31-33.
- FREWER, L., HOWARD, C. & SHEPHERD, R. 1997. Understanding risk perceptions associated with different food-processing technologies used in cheese production—a case study using conjoint analysis. *Food Quality and Preference*, 8, 271-290.
- FSAI. 2003. Consumer Attitudes to Food Safety in Ireland. Available: https://www.fsai.ie/uploadedfiles/monitoring_and_enforcement/consumer_attitudes.pdf [Accessed 3rd August 2015].
- FSANZ 2008. Food Industry Recall Protocol - A guide to conducting a food recall and writing a food recall plan. In: ZEALAND, F. S. A. N. (ed.) 6th ed.
- FSANZ. 2015. Cool and Reheat Food Safely - to the right temperatures. *Food Safety Standards Fact Sheets* [Online]. Available: http://www.foodstandards.gov.au/consumer/safety/faqsafety/documents/Cool%20and_reheat_food.pdf [Accessed 10/02/2016].
- FSANZ 2016. Food Safety: Storage and Temperatures.
- FUCCELLA, J. & PIZZOLATO, J. 1999. Giving people what they want: How to involve users in site design. *Formerly available online from IBM*.
- FYLAN, F. 2005. Semi structured interviewing. *A handbook of research methods for clinical and health psychology*, 65-78.
- GABLE, G. G. 1994. Integrating case study and survey research methods: an example in information systems. *European Journal of information systems*, 3, 112-126.
- GALLIERS, R. D. 1992. Choosing appropriate information systems research approaches: a revised taxonomy.

- GALLIERS, R. D. & LAND, F. F. 1987. Viewpoint: choosing appropriate information systems research methodologies. *Communications of the ACM*, 30, 901-902.
- GIBBS, A. 1997. Focus groups. *Social research update*, 19.
- GIBSON, J. 1977. The theory of affordances. *Perceiving, acting, and knowing: Toward an ecological psychology*, 67-82.
- GIBSON, J. J. 1986. *The ecological approach to visual perception*.
- GILBERT, C. L. 2010. How to understand high food prices. *Journal of Agricultural Economics*, 61, 398-425.
- GILBERT, S. E., WHYTE, R., BAYNE, G., PAULIN, S. M., LAKE, R. J. & VAN DER LOGT, P. 2007. Survey of domestic food handling practices in New Zealand. *International journal of food microbiology*, 117, 306-311.
- GLASER, B. G. 1992. *Emergence vs forcing: Basics of grounded theory analysis*, Sociology Press.
- GLASER, B. G. 1999. The future of grounded theory. *Qualitative health research*, 9, 836-845.
- GLASSER, B. 1992. *Emergence vs Forcing: Basics of Grounded Theory Analysis*. Mill Valley: Sociology Press.
- GOGUEN, J. 1997. Towards a social, ethical theory of information. *Social science, technical systems and cooperative work: beyond the great divide*, 27-56.
- GOLDEN, L. L. & ALPERT, M. I. 1987. Comparative analysis of the relative effectiveness of one-and two-sided communication for contrasting products. *Journal of Advertising*, 16, 18-68.
- GONG, J. & TARASEWICH, P. Guidelines for handheld mobile device interface design. Proceedings of DSI 2004 Annual Meeting, 2004. 3751-3756.
- GONG, S., WANG, X., YANG, Y. & BAI, L. 2016. Knowledge of food safety and handling in households: A survey of food handlers in Mainland China. *Food Control*, 64, 45-53.
- GOURLAY, S. 2000. Frameworks for knowledge: a contribution towards conceptual clarity for knowledge management.
- GRAHAM, I., HARRISON, M. & LOGAN, J. A review of planned change (knowledge translation) models, frameworks and theories. JBI International Convention, Adelaide, Australia, 2005.
- GRAHAM, I. D., LOGAN, J., HARRISON, M. B., STRAUS, S. E., TETROE, J., CASWELL, W. & ROBINSON, N. 2006. Lost in knowledge translation: time for a map? *Journal of Continuing Education in the Health Professions*, 26, 13-24.
- GRAHAM, I. D. & TETROE, J. 2007. Some theoretical underpinnings of knowledge translation. *Academic Emergency Medicine*, 14, 936-941.
- GREEN, M. C. 2004. Transportation into narrative worlds: The role of prior knowledge and perceived realism. *Discourse processes*, 38, 247-266.
- GREEN, M. C. & BROCK, T. C. 2002. In the mind's eye: Transportation-imagery model of narrative persuasion.
- GREENE, J. C., CARACELLI, V. J. & GRAHAM, W. F. 1989. Toward a conceptual framework for mixed-method evaluation designs. *Educational evaluation and policy analysis*, 11, 255-274.
- GRENON, P. & SMITH, B. 2011. Foundations of an ontology of philosophy. *Synthese*, 182, 185-204.
- GRIFFIN, R. J., DUNWOODY, S. & NEUWIRTH, K. 1999. Proposed model of the relationship of risk information seeking and processing to the development of preventive behaviors. *Environmental Research*, 80, S230-S245.

- GROSS, K. 2008. Framing persuasive appeals: Episodic and thematic framing, emotional response, and policy opinion. *Political Psychology*, 29, 169-192.
- GROVER, A. K., CHOPRA, S. & MOSHER, G. A. 2016. Food safety modernization act: A quality management approach to identify and prioritize factors affecting adoption of preventive controls among small food facilities. *Food Control*, 66, 241-249.
- GROVER, V. 1997. A Tutorial on survey research: from constructs to theory. Available: <http://people.clemson.edu/~vgrover/survey/MIS-SUVY.html> [Accessed 10th June 2013].
- GRUNERT, K., FREWER, L. & TRIJP, H. V. 2006. How consumers perceive food quality. *Understanding consumers of food products*, 181-199.
- GRUNERT, K. G. 2005. Food quality and safety: consumer perception and demand. *European Review of Agricultural Economics*, 32, 369-391.
- GRUNERT, K. G., BRUNSØ, K. & BISP, S. 1993. *Food-related life style: Development of a cross-culturally valid instrument for market surveillance*, MAPP Århus,, Denmark.
- GRUNERT, K. G., BRUNSØ, K., BRED AHL, L. & BECH, A. C. 2001. Food-related lifestyle: a segmentation approach to European food consumers. *Food, people and society*. Springer.
- GRUNERT, K. G., HIEKE, S. & WILLS, J. 2014. Sustainability labels on food products: Consumer motivation, understanding and use. *Food Policy*, 44, 177-189.
- GRUNERT, K. G., LÄHTEENMÄKI, L., BOZTUG, Y., MARTINSDÓTTIR, E., UELAND, Ø., ÅSTRÖM, A. & LAMPILA, P. 2009. Perception of health claims among Nordic consumers. *Journal of Consumer Policy*, 32, 269-287.
- GRUNERT, K. G., SCHOLDERER, J. & ROGEAUX, M. 2011. Determinants of consumer understanding of health claims. *Appetite*, 56, 269-277.
- GRUNERT, K. G., WILLS, J. M. & FERNÁNDEZ-CELEMÍN, L. 2010. Nutrition knowledge, and use and understanding of nutrition information on food labels among consumers in the UK. *Appetite*, 55, 177-189.
- GRUNERT O'BRIEN, J., MILLIS, B. J., COHEN, M. W. & DIAMOND, R. 2008. The course syllabus: A learning-centered approach.
- GUERRERO, L., GUÀRDIA, M. D., XICOLA, J., VERBEKE, W., VANHONACKER, F., ZAKOWSKA-BIEMANS, S., SAJDAKOWSKA, M., SULMONT-ROSSÉ, C., ISSANCHOU, S. & CONTEL, M. 2009. Consumer-driven definition of traditional food products and innovation in traditional foods. A qualitative cross-cultural study. *Appetite*, 52, 345-354.
- GUEST, G. S., MACQUEEN, K. M. & NAMEY, E. E. 2012. *Applied Thematic Analysis*, SAGE Publications Inc.
- HA, Y. & LENNON, S. J. 2010. Online visual merchandising (VMD) cues and consumer pleasure and arousal: purchasing versus browsing situation. *Psychology & Marketing*, 27, 141-165.
- HACCP. 2011. *HACCP system (7 Principles and 12 Steps based on Codex Alimentarius)* [Online]. Available: http://www.haccp-org.eu/food_safety/system.html [Accessed 6th July 2011].
- HADDON, L. 2006. The contribution of domestication research to in-home computing and media consumption. *The information society*, 22, 195-203.

- HALL, G., KIRK, M. D., BECKER, N., GREGORY, J. E., UNICOMB, L., MILLARD, G., STAFFORD, R. & LALOR, K. 2005. Estimating foodborne gastroenteritis, Australia. *Emerging Infectious Diseases*, 11, 1257-1264.
- HALL, R. & ANDRIANI, P. 2003. Managing knowledge associated with innovation. *Journal of Business Research*, 56, 145-152.
- HAMLIN, R. P. 2010. Cue-based decision making. A new framework for understanding the uninvolved food consumer. *Appetite*, 55, 89-98.
- HAMPRECHT, J., CORSTEN, D., NOLL, M. & MEIER, E. 2005. Controlling the sustainability of food supply chains. *Supply Chain Management: An International Journal*, 10, 7-10.
- HARDWICK, N. 2014. How to cook the perfect steak. *Good Food* [Online]. Available: <http://www.bbcgoodfood.com/howto/guide/how-cook-perfect-steak> [Accessed 10/02/2016].
- HARPER, G. & HENSON, S. 2001. Consumer concerns about animal welfare and the impact on food choice. *EU FAIR CT98-3678, Centre for Food Economics Research, The University of Reading*.
- HARSKAMP, E. G., MAYER, R. E. & SUHRE, C. 2007. Does the modality principle for multimedia learning apply to science classrooms? *Learning and Instruction*, 17, 465-477.
- HART, P. S. 2010. One or many? The influence of episodic and thematic climate change frames on policy preferences and individual behavior change. *Science Communication*.
- HARTMANN, C., DOHLE, S. & SIEGRIST, M. 2013. Importance of cooking skills for balanced food choices. *Appetite*, 65, 125-131.
- HASSAN, H. F. & DIMASSI, H. 2014. Food safety and handling knowledge and practices of Lebanese university students. *Food Control*, 40, 127-133.
- HE, Q., GHOBADIAN, A. & GALLEAR, D. 2013. Knowledge acquisition in supply chain partnerships: The role of power. *International Journal of Production Economics*, 141, 605-618.
- HEIJBEL, H. & JEFFERSON, T. 2001. Vaccine safety—improving monitoring. *Vaccine*, 19, 2457-2460.
- HENDERSON, J., COVENEY, J., WARD, P. R. & TAYLOR, A. W. 2011. Farmers are the most trusted part of the Australian food chain: results from a national survey of consumers. *Australian and New Zealand journal of public health*, 35, 319-324.
- HENLEY, S. C., STEIN, S. E. & QUINLAN, J. J. 2012. Identification of unique food handling practices that could represent food safety risks for minority consumers. *Journal of Food Protection*®, 75, 2050-2054.
- HENSON, S. 2008. The role of public and private standards in regulating international food markets. *Journal of International Agricultural Trade and Development*, 4, 63-81.
- HERNON, P. & SCHWARTZ, C. 2009. Reliability and validity. *Library & Information Science Research*, 31, 73-74.
- HERRLINGER, S., HÖFFLER, T. N., OPFERMANN, M. & LEUTNER, D. 2016. When Do Pictures Help Learning from Expository Text? Multimedia and Modality Effects in Primary Schools. *Research in Science Education*, 1-20.
- HILDRETH, P. M. & KIMBLE, C. 2002. The duality of knowledge. *Information Research*, 8, 8-1.

- HILLARY, F., SCHULTHEIS, M., CHALLIS, B., MILLIS, S., CARNEVALE, G., GALSHI, T. & DELUCA, J. 2003. Spacing of repetitions improves learning and memory after moderate and severe TBI. *Journal of Clinical and Experimental Neuropsychology*, 25, 49-58.
- HINYARD, L. J. & KREUTER, M. W. 2007. Using narrative communication as a tool for health behavior change: a conceptual, theoretical, and empirical overview. *Health Education & Behavior*, 34, 777-792.
- HIRSCHHEIM, R. & KLEIN, H. K. A research agenda for future information systems development methodologies. Challenges and strategies for research in systems development, 1992. John Wiley & Sons, Inc., 235-255.
- HIRSCHMAN, E. C. & SOLOMON, M. R. 1984. Utilitarian, Aesthetic, and Familiarity Responses to Verbal Versus Visual Advertisement. *Advances in consumer research*, 11.
- HJORTH, L. 2007. Snapshots of almost contact: The rise of camera phone practices and a case study in Seoul, Korea. *Continuum*, 21, 227-238.
- HOCQUETTE, J., BOTREAU, R., LEGRAND, I., POLKINGHORNE, R., PETHICK, D., LHERM, M., PICARD, B., DOREAU, M. & TERLOUW, E. 2014. Win-win strategies for high beef quality, consumer satisfaction, and farm efficiency, low environmental impacts and improved animal welfare. *Animal Production Science*, 54, 1537-1548.
- HOLLOWAY, I. & TODRES, L. 2003. The status of method: flexibility, consistency and coherence. *Qualitative research*, 3, 345-357.
- HONEYCUTT, A. & MILLIKEN, M. E. 2012. *Understanding human behavior: a guide for health care providers*, Cengage Learning.
- HORAI, J., NACCARI, N. & FATOULLAH, E. 1974. The effects of expertise and physical attractiveness upon opinion agreement and liking. *Sociometry*, 601-606.
- HORTON, J., MACVE, R. & STRUYVEN, G. 2004. Qualitative research: experiences in using semi-structured interviews. *The real life guide to accounting research*, 339-357.
- HOUDE, S. & HILL, C. 1997. What do prototypes prototype. *Handbook of human-computer interaction*, 2, 367-381.
- HOUGHTON, J. R., ROWE, G., FREWER, L., VAN KLEEF, E., CHRYSOCHOIDIS, G., KEHAGIA, O., KORZEN-BOHR, S., LASSEN, J., PFENNING, U. & STRADA, A. 2008. The quality of food risk management in Europe: Perspectives and priorities. *Food Policy*, 33, 13-26.
- HOVLAND, C. I. & WEISS, W. 1951. The influence of source credibility on communication effectiveness. *Public opinion quarterly*, 15, 635-650.
- HUANG, K.-T. 1997. Capitalizing collective knowledge for winning, execution and teamwork. *Journal of Knowledge Management*, 1, 149-156.
- HUGHES, J. A., O'BRIEN, J., RODDEN, T., ROUNCEFIELD, M. & BLYTHIN, S. Designing with ethnography: a presentation framework for design. Proceedings of the 2nd conference on Designing interactive systems: processes, practices, methods, and techniques, 1997. ACM, 147-158.
- HUGHES, M. 1999. Qualitative rigor in usability testing. *Currents*, 1999, 15-24.
- HUMPHREYS, L. 2012. Connecting, coordinating, cataloguing: Communicative practices on mobile social networks. *Journal of Broadcasting & Electronic Media*, 56, 494-510.
- HUTCHBY, I. 2001. Technologies, texts and affordances. *Sociology*, 35, 441-456.

- HWANG, G.-J., TSAI, C.-C., CHU, H.-C., KINSHUK, K. & CHEN, C.-Y. 2012. A context-aware ubiquitous learning approach to conducting scientific inquiry activities in a science park. *Australasian Journal of Educational Technology*, 28, 931-947.
- HYMAN, L., LAMB, J. & BULMER, M. The use of pre-existing survey questions: implications for data quality. Proceedings of the European Conference on Quality in Survey Statistics, 2006. Oxford University Press.
- INSCH, A. & JACKSON, E. 2013. Consumer understanding and use of country-of-origin in food choice. *British Food Journal*, 116, 62-79.
- INUKOLLU, V. N., KESHAMONI, D. D., KANG, T. & INUKOLLU, M. 2014. Factors influencing quality of mobile apps: Role of mobile app development life cycle. *arXiv preprint arXiv:1410.4537*.
- IPE, M. 2003. Knowledge sharing in organizations: A conceptual framework. *Human Resource Development Review*, 2, 337-359.
- ISO-22005:2007 2007. Traceability in the feed and food chain - General principles and basic requirements for system design and implementation.: International Organization for Standardization.
- ISO 1994. Quality management systems - Fundamentals and vocabulary ISO. International Organization for Standardization.
- ISO 1998. ISO 9241-11: Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs): Part 11: Guidance on Usability. International Organization for Standardization.
- ISPS. 2012. Why randomize? *Field experiments initiative* [Online]. Available: <http://isps.yale.edu/node/16697#.VsEpDPI9670> [Accessed 15/02/2016].
- ITO, M. E., OKABE, D. E. & MATSUDA, M. E. 2005. *Personal, portable, pedestrian: Mobile phones in Japanese life*, MIT press.
- JACKSON, A. 2013. Safe Food Handling. Available: http://www.olmcheidelberg.catholic.edu.au/our-community/OLMC_PA_Safe_Food_Handling_2013.pdf.
- JACOB, C., MATHIASSEN, L. & POWELL, D. 2010. Designing effective messages for microbial food safety hazards. *Food Control*, 21, 1-6.
- JANSEN-VULLERS, M. H., VAN DORP, C. A. & BEULENS, A. J. 2003. Managing traceability information in manufacture. *International Journal of Information Management*, 23, 395-413.
- JARVENPAA, S. & TOMAK, K. 2003. Competing in mobile business. *Competing in the Information Age*, Luftman, JN (ed.), 137-157.
- JASHAPARA, A. 2004. *Knowledge management: An integrated approach*, Pearson Education.
- JASIMUDDIN, S. M., KLEIN, J. H. & CONNELL, C. 2005. The paradox of using tacit and explicit knowledge: strategies to face dilemmas. *Management decision*, 43, 102-112.
- JEUNG, H. J., CHANDLER, P. & SWELLER, J. 1997. The role of visual indicators in dual sensory mode instruction. *Educational Psychology*, 17, 329-345.
- JOHNSON, H. H. & IZZETT, R. R. 1969. Relationship between authoritarianism and attitude change as a function of source credibility and type of communication. *Journal of Personality and Social Psychology*, 13, 317.
- JOHNSON, R. B. & ONWUEGBUZIE, A. J. 2004. Mixed methods research: A research paradigm whose time has come. *Educational researcher*, 33, 14-26.

- JONES, S. L., FERREIRA, D., HOSIO, S., GONCALVES, J. & KOSTAKOS, V. 2015. Revisitation analysis of smartphone app use. *Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing*. Osaka, Japan: ACM.
- JULIANO, J. 2004. Gen-X and Gen-Y: Teaching Them the Business An urgent need has arisen to pass on institutional knowledge to younger generations. But which teaching methods are best? *Public Utilities Fortnightly*, 142, 82-85.
- JUNG, Y. 2014. What a smartphone is to me: understanding user values in using smartphones. *Information systems journal*, 24, 299-321.
- KALYUGA, S., CHANDLER, P. & SWELLER, J. 2000. Incorporating learner experience into the design of multimedia instruction. *Journal of Educational Psychology*, 92, 126.
- KANERVA, A., KEEKER, K., RISDEN, K., SCHUH, E. & CZERWINSKI, M. 1997. Web usability research at Microsoft Corporation. *Human Factors for World Wide Web Development*, Lawrence Erlbaum, New York, United States of America.
- KARDES, F. R. 1988. Spontaneous inference processes in advertising: The effects of conclusion omission and involvement on persuasion. *Journal of consumer research*, 225-233.
- KARJALUOTO, H., PÜSCHEL, J., AFONSO MAZZON, J. & MAURO C. HERNANDEZ, J. 2010. Mobile banking: Proposition of an integrated adoption intention framework. *International Journal of Bank Marketing*, 28, 389-409.
- KARPICKE, J. D. & BAUERNSCHMIDT, A. 2011. Spaced retrieval: absolute spacing enhances learning regardless of relative spacing. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 37, 1250.
- KASSENS-NOOR, E. 2012. Twitter as a teaching practice to enhance active and informal learning in higher education: The case of sustainable tweets. *Active Learning in Higher Education*, 13, 9-21.
- KEIL, M., IM, G. P. & MÄHRING, M. 2007. Reporting bad news on software projects: the effects of culturally constituted views of face-saving. *Information systems journal*, 17, 59-87.
- KELEPOURIS, T., PRAMATARI, K. & DOUKIDIS, G. 2007. RFID-enabled traceability in the food supply chain. *Industrial Management & Data Systems*, 107, 183-200.
- KELLER, P. A. & BLOCK, L. G. 1997. Vividness effects: A resource-matching perspective. *Journal of consumer research*, 24, 295-304.
- KENNEDY, J., JACKSON, V., COWAN, C., BLAIR, I., MCDOWELL, D. & BOLTON, D. 2005. Consumer food safety knowledge: Segmentation of Irish home food preparers based on food safety knowledge and practice. *British Food Journal*, 107, 441-452.
- KERFOOT, B. P., DEWOLF, W. C., MASSER, B. A., CHURCH, P. A. & FEDERMAN, D. D. 2007. Spaced education improves the retention of clinical knowledge by medical students: a randomised controlled trial. *Medical education*, 41, 23-31.
- KIM, M. & LENNON, S. 2008. The effects of visual and verbal information on attitudes and purchase intentions in internet shopping. *Psychology & Marketing*, 25, 146-178.

- KIM, M. & LENNON, S. J. 2000. Television shopping for apparel in the United States: effects of perceived amount of information on perceived risks and purchase intentions. *Family and Consumer Sciences Research Journal*, 28, 301-331.
- KIMBLE, C., HILDRETH, P. & WRIGHT, P. 2001. Communities of practice: going virtual. *Knowledge management and business model innovation*, 220-234.
- KIMURA, A., WADA, Y., TSUZUKI, D., GOTO, S.-I., CAI, D. & DAN, I. 2008. Consumer valuation of packaged foods. Interactive effects of amount and accessibility of information. *Appetite*, 51, 628-634.
- KING, R. P. & PHUMPIU, P. F. 1996. Reengineering the food supply chain: the ECR initiative in the grocery industry. *American Journal of Agricultural Economics*, 78, 1181-1186.
- KISIELIUS, J. & STERNTHAL, B. 1986. Examining the vividness controversy: An availability-valence interpretation. *Journal of consumer research*, 418-431.
- KITZINGER, J. 1995. Qualitative research. Introducing focus groups. *British Medical Journal*, 311, 299-302.
- KNAPP, C., MADDEN, V., WANG, H., SLOYER, P. & SHENKMAN, E. 2011. Internet use and eHealth literacy of low-income parents whose children have special health care needs. *Journal of Medical Internet Research*, 13.
- KNOWLES, M. S. 1970. The modern practice of adult education: Andragogy vs. pedagogy. New York: Association Press.
- KNOWLES, M. S., HOLTON III, E. F. & SWANSON, R. A. 1998. The Adult Learner. The Definitive Classic in Adult Education and Human Resource Development.
- KNOWLES, M. S., HOLTON III, E. F. & SWANSON, R. A. 2014. *The adult learner: The definitive classic in adult education and human resource development*, Routledge.
- KNUPFER, N. N. & MCLELLAN, H. 2001. Descriptive Research Methodologies. *Handbook of Research*. The Association for Educational Communications and Technology.
- KOEHLER, A. & SOM, C. 2005. Effects of pervasive computing on sustainable. *IEEE Technology and Society Magazine*, 24, 15-23.
- KOH, C., ANG, S. & STRAUB, D. W. 2004. IT outsourcing success: a psychological contract perspective. *Information Systems Research*, 15, 356-373.
- KOSA, K. M., CATES, S. C., BRADLEY, S., CHAMBERS IV, E. & GODWIN, S. 2015. Consumer-reported handling of raw poultry products at home: results from a national survey. *Journal of food protection*, 78, 180-186.
- KOSKINEN, I. 2017. *Mobile multimedia in action*, Routledge.
- KOUSTA, M., MATARAGAS, M., SKANDAMIS, P. & DROSINOS, E. H. 2010. Prevalence and sources of cheese contamination with pathogens at farm and processing levels. *Food Control*, 21, 805-815.
- KRATHWOHL, D. R. 1993. *Methods of educational and social science research: An integrated approach*, Longman/Addison Wesley Longman.
- KRUGER, J. & DUNNING, D. 1999. Unskilled and unaware of it: how difficulties in recognizing one's own incompetence lead to inflated self-assessments. *Journal of Personality and Social Psychology*, 77, 1121.
- KRYSTALLIS, T., FREWER, L., ROWE, G. & HOUGHTON, J. 2007. Cross-country comparisons in consumers' and experts' perception of food risk management: Denmark, Germany, Greece and the UK. *Health, Risk and Society*.

- KUSHNIRUK, A. 2002. Evaluation in the design of health information systems: application of approaches emerging from usability engineering. *Computers in biology and medicine*, 32, 141-149.
- KUSHNIRUK, A. W., PATEL, V. L. & CIMINO, J. J. Usability testing in medical informatics: Cognitive approaches to evaluation of information systems and user interfaces. Proceedings of the AMIA annual fall symposium, 1997. American Medical Informatics Association, 218.
- KUTTSCHREUTER, M. 2006. Psychological determinants of reactions to food risk messages. *Risk analysis*, 26, 1045-1057.
- KUTTSCHREUTER, M., RUTSAERT, P., HILVERDA, F., REGAN, Á., BARNETT, J. & VERBEKE, W. 2014. Seeking information about food-related risks: The contribution of social media. *Food Quality and Preference*, 37, 10-18.
- LADD, D. A., DATTA, A., SARKER, S. & YU, Y. 2010. Trends in mobile computing within the IS discipline: A ten-year retrospective. *Communication of Association of Information Systems (CAIS)*, 27, 285-316.
- LAESTADIUS, L. I., LAGASSE, L. P., SMITH, K. C. & NEFF, R. A. 2012. Print news coverage of the 2010 Iowa egg recall: Addressing bad eggs and poor oversight. *Food Policy*, 37, 751-759.
- LANKSHEAR, A. J. 1993. The use of focus groups in a study of attitudes to student nurse assessment. *Journal of Advanced Nursing*, 18, 1986-1989.
- LAURIER, E. 2001. Why people say where they are during mobile phone calls. *Environment and Planning D: Society and Space*, 19, 485-504.
- LAZOU, T., GEORGIADIS, M., PENTIEVA, K., MCKEVITT, A. & IOSSIFIDOU, E. 2012. Food safety knowledge and food-handling practices of Greek university students: A questionnaire-based survey. *Food Control*, 28, 400-411.
- LEAHY, W. & SWELLER, J. 2011. Cognitive load theory, modality of presentation and the transient information effect. *Applied Cognitive Psychology*, 25, 943-951.
- LEATHWOOD, P. D., RICHARDSON, D. P., STRÄTER, P., TODD, P. M. & VAN TRIJP, H. 2007. Consumer understanding of nutrition and health claims: sources of evidence. *British Journal of Nutrition*, 98, 474-484.
- LEE, A. S. 1989. A scientific methodology for MIS case studies. *MIS quarterly*, 33-50.
- LENHART, A., LING, R., CAMPBELL, S. & PURCELL, K. 2010. Teens and mobile phones: Text messaging explodes as teens embrace it as the centerpiece of their communication strategies with friends. *Pew Internet & American Life Project*.
- LEONARD-BARTON, D. 1990. A dual methodology for case studies: synergistic use of a longitudinal single site with replicated multiple sites. *Organization Science*, 1, 248-266.
- LEONARD, D. & SENSIPER, S. 1998. The role of tacit knowledge in group innovation. *California management review*, 40.
- LESLIE, M., PARADIS, E., GROPPER, M. A., REEVES, S. & KITTO, S. 2014. Applying ethnography to the study of context in healthcare quality and safety. *BMJ Qual Saf*, 23, 99-105.
- LEV, E. 2009. *Googling While Expecting: Internet Use by Israeli Women during Pregnancy*. Ohio University.
- LEVETT-JONES, T., LAPKIN, S., HOFFMAN, K., ARTHUR, C. & ROCHE, J. 2011. Examining the impact of high and medium fidelity simulation experiences on nursing students' knowledge acquisition. *Nurse Education in Practice*, 11, 380-383.

- LEVITT, S. D. & LIST, J. A. 2007. What do laboratory experiments measuring social preferences reveal about the real world? *The journal of economic perspectives*, 21, 153-174.
- LICOPPE, C. 2004. 'Connected'presence: The emergence of a new repertoire for managing social relationships in a changing communication technoscape. *Environment and Planning D: Society and Space*, 22, 135-156.
- LIM, Y.-K., PANGAM, A., PERIYASAMI, S. & ANEJA, S. Comparative analysis of high-and low-fidelity prototypes for more valid usability evaluations of mobile devices. Proceedings of the 4th Nordic conference on Human-computer interaction: changing roles, 2006. ACM, 291-300.
- LIN, T. M., LU, K.-Y. & WU, J.-J. 2012. The effects of visual information in eWOM communication. *Journal of Research in Interactive Marketing*, 6, 7-26.
- LING, R. 2008. *Trust, Cohesion and Social Networks The Case of Quasi-Illicit Photos in a Teen Peer Group*, na.
- LING, R. & YTTRI, B. 2002. 10 Hyper--coordination via mobile phones in Norway. *Perpetual contact: Mobile communication, private talk, public performance*, 139.
- LINTONEN, T., KONU, A. & SEEDHOUSE, D. 2008. Information technology in health promotion. *Health education research*, 23, 560-566.
- LIRTZMAN, S. I. & SHUV-AMI, A. 1986. Credibility of Sources of Communication on Product's Safety Hazards. *Psychological reports*, 58, 707-718.
- LIST, J. A. & METCALFE, R. 2014. Field experiments in the developed world: an introduction. *Oxford Review of Economic Policy*, 30, 585-596.
- LIU, R., HOEFKENS, C. & VERBEKE, W. 2015. Chinese consumers' understanding and use of a food nutrition label and their determinants. *Food Quality and Preference*, 41, 103-111.
- LIU, R., PIENIAK, Z. & VERBEKE, W. 2013. Consumers' attitudes and behaviour towards safe food in China: A review. *Food Control*, 33, 93-104.
- LIU, R., PIENIAK, Z. & VERBEKE, W. 2014. Food-related hazards in China: Consumers' perceptions of risk and trust in information sources. *Food Control*, 46, 291-298.
- LIU, T.-C., LIN, Y.-C., TSAI, M.-J. & PAAS, F. 2012. Split-attention and redundancy effects on mobile learning in physical environments. *Computers & Education*, 58, 172-180.
- LJUBOJEVIC, M., VASKOVIC, V., STANKOVIC, S. & VASKOVIC, J. 2014. Using supplementary video in multimedia instruction as a teaching tool to increase efficiency of learning and quality of experience. *The International Review of Research in Open and Distributed Learning*, 15.
- LONGHURST, R. 2003. Semi-structured interviews and focus groups. *Key methods in geography*, 117-132.
- LOSASSO, C., CIBIN, V., CAPPAS, V., ROCCATO, A., VANZO, A., ANDRIGHETTO, I. & RICCI, A. 2012. Food safety and nutrition: Improving consumer behaviour. *Food Control*, 26, 252-258.
- LOUVIERE, J. The best-worst or maximum difference measurement model: Applications to behavioral research in marketing. The American Marketing Association's Behavioral Research Conference Phoenix, Arizona, 1993.
- LOUVIERE, J. J. & FLYNN, T. N. 2010. Using best-worst scaling choice experiments to measure public perceptions and preferences for healthcare reform in Australia. *The Patient: Patient-Centered Outcomes Research*, 3, 275-283.

- LOUVIERE, J. J. & WOODWORTH, G. 1991. Best-worst scaling: A model for the largest difference judgments.
- LU, Y., DENG, Z. & WANG, B. 2010. Exploring factors affecting Chinese consumers' usage of short message service for personal communication. *Information systems journal*, 20, 183-208.
- LUO, S., JIN, J. & LI, J. 2009. A smart fridge with an ability to enhance health and enable better nutrition. *International Journal of Multimedia and Ubiquitous Engineering*, 4, 66-80.
- LUO, S., XIA, H., GAO, Y., JIN, J. S. & ATHAUDA, R. Smart fridges with multimedia capability for better nutrition and health. Ubiquitous Multimedia Computing, 2008. UMC'08. International Symposium on, 2008. IEEE, 39-44.
- LUSK, J. L. & BRIGGEMAN, B. C. 2009. Food values. *American Journal of Agricultural Economics*, 91, 184-196.
- LÜTKE ENTRUP, M. 2005. Advanced planning in fresh food industries: integrating shelf life into production planning. *Physica, Heidelberg*.
- LUXTON, D. D., MCCANN, R. A., BUSH, N. E., MISHKIND, M. C. & REGER, G. M. 2011. mHealth for mental health: Integrating smartphone technology in behavioral healthcare. *Professional Psychology: Research and Practice*, 42, 505.
- MACINNIS, D. J. 2004. *Consumer behavior*, Houghton Mifflin College Div.
- MADDUX, J. E. & ROGERS, R. W. 1980. Effects of source expertness, physical attractiveness, and supporting arguments on persuasion: A case of brains over beauty. *Journal of Personality and Social Psychology*, 39, 235.
- MAJCHRZAK, A., FARAJ, S., KANE, G. C. & AZAD, B. 2013. The contradictory influence of social media affordances on online communal knowledge sharing. *Journal of Computer-Mediated Communication*, 19, 38-55.
- MARLEY, A. 2009. *The best-worst method for the study of preferences: theory and application*. Psychology Press.
- MARLEY, A. A. & LOUVIERE, J. J. 2005. Some probabilistic models of best, worst, and best-worst choices. *Journal of Mathematical Psychology*, 49, 464-480.
- MÅRTENSSON, M. 2000. A critical review of knowledge management as a management tool. *Journal of Knowledge Management*, 4, 204-216.
- MARTIN, S. 1999. Cluster analysis for web site organization. *Internetworking*, Dec.
- MARTINS, E. & MARTINS, N. 2011. The role of organisational factors in combating tacit knowledge loss in organisations. *Southern African Business Review*, 15.
- MASON, L. 1996. Collaborative reasoning on self-generated analogies: conceptual growth in understanding scientific phenomena. *Educational Research and Evaluation*, 2, 309-350.
- MATEUS, T., MAIA, R. L. & TEIXEIRA, P. 2014. Awareness of listeriosis among Portuguese pregnant women. *Food Control*, 46, 513-519.
- MAYER, A. B. & HARRISON, J. A. 2012. The Use of Online Focus Groups to Design An Online Food Safety Education Intervention. *Journal of Food Science Education*, 11, 47-51.
- MAYER, R. E. 2002. Rote versus meaningful learning. *Theory into practice*, 41, 226-232.
- MAYER, R. E. 2005a. *The Cambridge handbook of multimedia learning*, Cambridge University Press.
- MAYER, R. E. 2005b. Principles for managing essential processing in multimedia learning: Segmenting, pretraining, and modality principles. *The Cambridge handbook of multimedia learning*, 169-182.

- MAYER, R. E. 2009. *Multimedia learning*, Cambridge university press.
- MAYER, R. E. 2014. Cognitive theory of multimedia learning. *The Cambridge handbook of multimedia learning*, 43.
- MAYER, R. E. & CHANDLER, P. 2001. When learning is just a click away: Does simple user interaction foster deeper understanding of multimedia messages? *Journal of Educational Psychology*, 93, 390.
- MAYER, R. E., HEISER, J. & LONN, S. 2001. Cognitive constraints on multimedia learning: When presenting more material results in less understanding. *Journal of Educational Psychology*, 93, 187.
- MAYER, R. E. & MORENO, R. 2003. Nine ways to reduce cognitive load in multimedia learning. *Educational Psychologist*, 38, 43-52.
- MCCABE, D. P., ROEDIGER III, H. L., MCDANIEL, M. A., BALOTA, D. A. & HAMBRICK, D. Z. 2010. The relationship between working memory capacity and executive functioning: evidence for a common executive attention construct. *Neuropsychology*, 24, 222.
- MCCOACH, D. B., GOLDSTEIN, J., BEHUNIAK, P., REIS, S. M., BLACK, A. C., SULLIVAN, E. E. & RAMBO, K. 2010. Examining the unexpected: Outlier analyses of factors affecting student achievement. *Journal of Advanced Academics*, 21, 426-468.
- MCCURDIE, T., TANEVA, S., CASSELMAN, M., YEUNG, M., MCDANIEL, C., HO, W. & CAFAZZO, J. 2012. mHealth consumer apps: the case for user-centered design. *Biomedical Instrumentation & Technology*, 46, 49-56.
- MCGUIRE, W. J. 1976. Some internal psychological factors influencing consumer choice. *Journal of consumer research*, 302-319.
- MCLEOD, J. 2003. Qualitative research methods in counselling psychology.
- MCMAHON, D. D., CIHAK, D. F., GIBBONS, M. M., FUSSELL, L. & MATHISON, S. 2013. Using a mobile app to teach individuals with intellectual disabilities to identify potential food allergens. *Journal of Special Education Technology*, 28, 21-32.
- MCMEEKIN, T. A., BARANYI, J., BOWMAN, J., DALGAARD, P., KIRK, M., ROSS, T., SCHMID, S. & ZWIETERING, M. H. 2006. Information systems in food safety management. *International journal of food microbiology*, 112, 181-194.
- MCPHERSON, M. 1983. An ecology of affiliation. *American Sociological Review*, 519-532.
- MCTIGUE, E. M. 2009. Does multimedia learning theory extend to middle-school students? *Contemporary Educational Psychology*, 34, 143-153.
- MEADOW, C. T., KRAFT, D. H. & BOYCE, B. R. 1999. *Text information retrieval systems*, Academic Press, Inc.
- MENDENHALL, W., REINMUTH, J. & BEAVER, R. 1989. *Statistics for Management and Economics* (PWS. Kent Publishing, Boston, MA).
- MERRIAM, S. B. 1988. *Case study research in education: A qualitative approach*, Jossey-Bass.
- MEYER, C. B. 2001. A case in case study methodology. *Field methods*, 13, 329-352.
- MIGLIORATI, G., PRENCIPE, V. A., IANNETTI, L., DI GIANNATALE, E., MATTEUCCI, O., SALINI, R. & CALISTRI, P. 2013. Survey of domestic food purchases and related home handling practices in the Abruzzo region (central Italy): Data collection and analysis through a language-independent classification system. *Food Control*.

- MILES, M. B. & HUBERMAN, A. M. 1994. *Qualitative data analysis: An expanded sourcebook*, Sage.
- MITCHELL, K. 2000. Knowledge management: the next big thing. *Public Manager*, 29, 57-60.
- MLA. 2015. *Cooking Times and Conversion Table* [Online]. Available: http://www.beefandlamb.com.au/how_to/cooking_beef_and_lamb/tools_and_ap ps/cooking_times_and_conversion_table.
- MLAMBO, V. 2012. An analysis of some factors affecting student academic performance in an introductory biochemistry course at the University of the West Indies. *The Caribbean Teaching Scholar*, 1.
- MOM, T. J., VAN DEN BOSCH, F. A. & VOLBERDA, H. W. 2007. Investigating managers' exploration and exploitation activities: The influence of top-down, bottom-up, and horizontal knowledge inflows. *Journal of Management Studies*, 44, 910-931.
- MONKMAN, H. & KUSHNIRUK, A. A health literacy and usability heuristic evaluation of a mobile consumer health application. *MedInfo*, 2013. 724-728.
- MORELAND, R. L., LEVINE, J. & WINGERT, M. 2013. Creating the ideal group: Composition effects at work. *Understanding group behavior*, 2, 11-35.
- MORENO, R. & MAYER, R. E. 2005. Role of guidance, reflection, and interactivity in an agent-based multimedia game. *Journal of Educational Psychology*, 97, 117.
- MORSE, J. M. 2003. Principles of mixed methods and multimethod research design. *Handbook of mixed methods in social and behavioral research*, 189-208.
- MULLAN, B., ALLOM, V., FAYN, K. & JOHNSTON, I. 2014. Building habit strength: A pilot intervention designed to improve food-safety behavior. *Food Research International*, 66, 274-278.
- MULLAN, B. & WONG, C. 2010. Using the Theory of Planned Behaviour to design a food hygiene intervention. *Food Control*, 21, 1524-1529.
- MURPHY, P. W., CHESSON, A. L., WALKER, L., ARNOLD, C. L. & CHESSON, L. M. 2000. Comparing the effectiveness of video and written material for improving knowledge among sleep disorders clinic patients with limited literacy skills. *Southern medical journal*, 93, 297-304.
- MYERS, M. D. 1997. Qualitative research in information systems. *Management Information Systems Quarterly*, 21, 241-242.
- NESBITT, A., THOMAS, M. K., MARSHALL, B., SNEDEKER, K., MELETA, K., WATSON, B. & BIENEFELD, M. 2014. Baseline for consumer food safety knowledge and behaviour in Canada. *Food Control*, 38, 157-173.
- NEUMAN, W. L. 2005. *Social research methods: Quantitative and qualitative approaches*, Allyn and Bacon.
- NIELSEN, J. 2003. Usability 101: Introduction to usability.
- NIELSEN, J. & NORMAN, D. 2000. Web-site usability: usability on the web isn't a luxury. *Information week*, 773.
- NIELSEN, J. & SANO, D. 1995. SunWeb: User interface design for Sun Microsystem's internal web. *Computer Networks and ISDN Systems*, 28, 179-188.
- NONAKA, I. 1994. A dynamic theory of organizational knowledge creation. *Organization Science*, 5, 14-37.
- NOVAK, J. D. 2002. Meaningful learning: The essential factor for conceptual change in limited or inappropriate propositional hierarchies leading to empowerment of learners. *Science Education*, 86, 548-571.

- NSWFA. 2014. Food Poisoning. Available: <http://www.foodauthority.nsw.gov.au/consumers/problems-with-food/food-poisoning/#.VbGjffmqpBc> [Accessed 24/07/2015].
- NSWFA. 2015a. Food at Home - Cooking Temperatures. Available: http://www.foodauthority.nsw.gov.au/foodsafetyandyou/food-at-home/cooking-temperatures?utm_campaign=redirected#.VjalqrerK70 [Accessed 10/02/2016].
- NSWFA. 2015b. Raw meat safe eating. Available: <http://www.foodauthority.nsw.gov.au/foodsafetyandyou/special-care-foods/raw-meat-safe-eating> [Accessed 24/02/2017].
- NUNAN, D. 2012. *What is this thing called language?*, Palgrave Macmillan.
- NURMULIANI, N., ZOWGHI, D. & WILLIAMS, S. P. Using card sorting technique to classify requirements change. Requirements Engineering Conference, 2004. Proceedings. 12th IEEE International, 2004. IEEE, 240-248.
- O'DONOHUE, S. 1994. Advertising uses and gratifications. *European Journal of Marketing*, 28, 52-75.
- O'TOOLE, G. 2016. *Communication: Core Interpersonal Skills for Health Professionals*, Elsevier - Health Sciences Division.
- OGLETHORPE, D. & HERON, G. 2010. Sensible operational choices for the climate change agenda. *The International Journal of Logistics Management*, 21, 538-557.
- OLIVEIRA, L. C. R. D., MITCHELL, V. A. & MAY, A. J. 2013. Designing a smart phone app for sustainable cooking. *Proceedings of the 2013 ACM conference on Pervasive and ubiquitous computing adjunct publication*. Zurich, Switzerland: ACM.
- OLSEN, N. V., RØSSVOLL, E., LANGSRUD, S. & SCHOLDERER, J. 2014. Hamburger hazards and emotions. *Appetite*, 78, 95-101.
- OLSEN, P. & ASCHAN, M. 2010. Reference method for analyzing material flow, information flow and information loss in food supply chains. *Trends in Food Science & Technology*, 21, 313-320.
- OMURTAG, I., PAULSEN, P., HILBERT, F. & SMULDERS, F. J. 2013. The risk of transfer of foodborne bacterial hazards in Turkey through the consumption of meat; risk ranking of muscle foods with the potential to transfer *Campylobacter* spp. *Food security*, 5, 117-127.
- ONWUEGBUZIE, A. J. & JOHNSON, R. B. 2006. The validity issue in mixed research. *Research in the Schools*, 13, 48-63.
- OPPENHEIM, C., STENSON, J. & WILSON, R. M. 2003. Studies on information as an asset I: definitions. *Journal of Information Science*, 29, 159-166.
- ORLIKOWSKI, W. J. & BAROUDI, J. J. 1991. Studying information technology in organizations: Research approaches and assumptions. *Information Systems Research*, 2, 1-28.
- ORSI, G. B., NATALE, F., D'ETTORRE, G., PROTANO, C., VULLO, V. & DE CURTIS, M. 2015. Mobile phone microbial contamination among neonatal unit healthcare workers. *Infection Control & Hospital Epidemiology*, 36, 487-489.
- ORTEGA, D. L., WANG, H. H., WU, L. & OLYNK, N. J. 2011. Modeling heterogeneity in consumer preferences for select food safety attributes in China. *Food Policy*, 36, 318-324.
- ORWAT, C., GRAEFE, A. & FAULWASSER, T. 2008. Towards pervasive computing in health care—A literature review. *BMC Medical Informatics and Decision Making*, 8, 1.

- OTTATI, V., PRICE, E. D., WILSON, C. & SUMAKTOYO, N. 2015. When self-perceptions of expertise increase closed-minded cognition: The earned dogmatism effect. *Journal of Experimental Social Psychology*, 61, 131-138.
- OULASVIRTA, A., RATTENBURY, T., MA, L. & RAITA, E. 2012. Habits make smartphone use more pervasive. *Personal and Ubiquitous Computing*, 16, 105-114.
- OVCA, A. & JEVŠNIK, M. 2009. Maintaining a cold chain from purchase to the home and at home: Consumer opinions. *Food Control*, 20, 167-172.
- OVCA, A., JEVŠNIK, M. & RASPOR, P. 2014. Food safety awareness, knowledge and practices among students in Slovenia. *Food Control*, 42, 144-151.
- OZFOODNET 2012. Monitoring the incidence and causes of diseases potentially transmitted by food in Australia: Annual report of the OzFoodNet network, 2010. *Communicable diseases intelligence quarterly report*, 36, E213-41.
- OZFOODNET 2015. OzFoodNet Quarterly Report. *Communicable diseases intelligence quarterly report*, 39.
- PAAS, F. & VAN GOG, T. 2006. Optimising worked example instruction: Different ways to increase germane cognitive load. *Learning and Instruction*, 16, 87-91.
- PARHIZGARI, N., FARAJZADEH SHEIKH, A. & SADEGHI, P. 2014. Identification of bacteria isolated from mobile phones of three medical and teaching hospitals administrative and medical staff in Ahvaz. *Jentashapir Journal of Health Research*, 4, 397-403.
- PARK, Y. 2011. A pedagogical framework for mobile learning: Categorizing educational applications of mobile technologies into four types. *The International Review of Research in Open and Distributed Learning*, 12, 78-102.
- PARRA, P. A., KIM, H., SHAPIRO, M. A., GRAVANI, R. B. & BRADLEY, S. D. 2014. Home food safety knowledge, risk perception, and practices among Mexican-Americans. *Food Control*, 37, 115-125.
- PATEL, D. 2016. Minimizing Cognitive Overload while Designing the Mobile User Experience. Available: <https://www.apptentive.com/blog/2016/12/07/cognitive-overload-in-mobile-user-experience/> [Accessed 26/02/2018].
- PATIL, B. 2013. Knowledge Retention Techniques for Architectural Education. *IAMURE International Journal of Education*, 5, 1-1.
- PATTON, M. Q. 1990. *Qualitative evaluation and research methods*, SAGE Publications, inc.
- PEA, R. D. & MALDONADO, H. 2006. WILD for learning: Interacting through new computing devices anytime, anywhere. *The Cambridge handbook of the learning sciences*, 852-886.
- PEDERSEN, P. E. 2005. Adoption of mobile Internet services: An exploratory study of mobile commerce early adopters. *Journal of Organizational Computing and Electronic Commerce*, 15, 203-222.
- PETERS, K. 2007. m-Learning: Positioning educators for a mobile, connected future. *The International Review of Research in Open and Distributed Learning*, 8.
- PETTY, R. E. & CACIOPPO, J. T. 1986. *The elaboration likelihood model of persuasion*, Springer.
- PFAU, M., HOLBERT, R. L., ZUBRIC, S. J., PASHA, N. H. & LIN, W.-K. 2000. Role and influence of communication modality in the process of resistance to persuasion. *Media Psychology*, 2, 1-33.
- PHILLIP, S. & ANITA, E. 2010. Efficacy of the theory of planned behaviour model in predicting safe food handling practices. *Food Control*, 21, 983-987.

- PI-HSIA, H., HWANG, G.-J., I-HSIANG, S. & I-HUA, L. 2012. A concept-map integrated dynamic assessment system for improving ecology observation competences in mobile learning activities. *TOJET: The Turkish Online Journal of Educational Technology*, 11.
- PIENIAK, Z., VANHONACKER, F. & VERBEKE, W. 2013. Consumer knowledge and use of information about fish and aquaculture. *Food Policy*, 40, 25-30.
- PINTO, D., CASTRO, I. & VICENTE, A. 2006. The use of TIC's as a managing tool for traceability in the food industry. *Food Research International*, 39, 772-781.
- PLACE, I. M. G. & HYSLOP, D. 1982. *Records management, controlling business information*, Reston Publishing Company.
- POLANYI, M. 1967. The tacit dimension. 1967. *The example of the paper on gestation periods is also from Polanyi*, 64.
- POLKINGHORNE, R., WATSON, R., THOMPSON, J. & PETHICK, D. 2008. Current usage and future development of the Meat Standards Australia (MSA) grading system. *Animal Production Science*, 48, 1459-1464.
- PORNPITAKPAN, C. 2004. The persuasiveness of source credibility: A critical review of five decades' evidence. *Journal of Applied Social Psychology*, 34, 243-281.
- PRAKASH, A. & L'AGRICULTURE, O. D. N. U. P. L. A. E. 2011. *Safeguarding food security in volatile global markets*, Food and Agriculture Organization of the United Nations.
- PRESCOTT, P. & MANSSON, R. 2004. Robustness of diallel cross designs to the loss of one or more observations. *Computational statistics & data analysis*, 47, 91-109.
- PRICE, S., VIGLIA, G., HARTWELL, H., HEMINGWAY, A., CHAPLEO, C., APPLETON, K., SAULAI, L., MAVRIDIS, I. & PEREZ-CUETO, F. J. 2016. What are we eating? Consumer information requirement within a workplace canteen. *Food Quality and Preference*, 53, 39-46.
- PRUSSAK, L. & DAVENPORT, T. 1998. Conhecimento Empresarial-Como as Organizações Gerenciam o Seu Capital Intelectual. *Rio de Janeiro: Campus*.
- PURTILO, R. B., HADDAD, A. M. & DOHERTY, R. F. 2014. *Health professional and patient interaction*, Elsevier Health Sciences.
- RACHERLA, P., FURNER, C. & BABB, J. 2012. Conceptualizing the implications of mobile app usage and stickiness: A research agenda. *Available at SSRN 2187056*.
- RAINIE, L. & WELLMAN, B. 2012. *Networked: The new social operating system*, Mit Press.
- RAJASEKAR, S., PHILOMINATHAN, P. & CHINNATHAMBI, V. 2006. Research methodology. *arXiv preprint physics/0601009*.
- RAPLEY, T. 2008. *Doing conversation, discourse and document analysis*, Sage.
- REEVES, B. C., DEEKS, J. J. & HIGGINS, J. P. 2008. 13 Including non-randomized studies. *Cochrane handbook for systematic reviews of interventions*, 1, 391.
- REGATTIERI, A., GAMBERI, M. & MANZINI, R. 2007. Traceability of food products: General framework and experimental evidence. *Journal of Food Engineering*, 81, 347-356.
- REICHER, S. & TAYLOR, S. 2005. Similarities and differences between traditions. *Psychologist*, 18, 547-549.
- REID, J. & ROUT, M. 2016. Getting to know your food: The insights of indigenous thinking in food provenance. *Agriculture and Human Values*, 33, 427-438.

- REID, M., LI, E., BRUWER, J. & GRUNERT, K. 2001. Food-related lifestyles in a cross-cultural context: Comparing Australia with Singapore, Britain, France and Denmark. *Journal of Food Products Marketing*, 7, 57-75.
- RIELLA, L. V. 2016. Digital Learning in Transplantation. *Transplantation*, 100, 701-702.
- RIMAL, R. N. 2000. Closing the Knowledge-Behavior Gap in Health Promotion: The Mediating Role of Self-Efficacy. *Health Communication*, 12, 219-237.
- ROEBUCK, H., MORAN, K., MACDONALD, D. A., SHUMER, S. & MCCUNE, R. L. 2015. Assessing Skin Cancer Prevention and Detection Educational Needs: An Andragogical Approach. *The Journal for Nurse Practitioners*, 11, 409-416.
- ROGEAUX, M., JAEGER, S. & MACFIE, H. 2010. Consumer understanding and reaction to health claims: insights and methodology. *Consumer-driven innovation in food and personal care products*, 277-302.
- ROGERS, Y. & BELLOTTI, V. 1997. Grounding blue-sky research: how can ethnography help? *Interactions*, 4, 58-63.
- ROGERS, Y., SHARP, H. & PREECE, J. 2011a. Interaction design: beyond human-computer interaction.
- ROGERS, Y., SHARP, H. & PREECE, J. 2011b. *Interaction design: beyond human-computer interaction*, Chichester, John Wiley & Sons.
- RÖHR, A., LÜDDECKE, K., DRUSCH, S., MÜLLER, M. & ALVENSLEBEN, R. 2005. Food quality and safety—consumer perception and public health concern. *Food Control*, 16, 649-655.
- ROMPOTIS, C. J., GROVE, J. R. & BYRNE, S. M. 2014. Benefits of habit-based informational interventions: a randomised controlled trial of fruit and vegetable consumption. *Australian and New Zealand journal of public health*, 38, 247-252.
- ROOTMAN, I. & GORDON-EL-BIHBETY, D. 2008. A vision for a health literate Canada. *Ottawa, ON: Canadian Public Health Association*.
- ROSSITER, J. R. & PERCY, L. 1980. Attitude change through visual imagery in advertising. *Journal of Advertising*, 9, 10-16.
- ROYAL_SOCIETY 1992. *Risk: Analysis, perception and management*.
- RUGG, G. & MCGEORGE, P. 2005. The sorting techniques: a tutorial paper on card sorts, picture sorts and item sorts. *Expert Systems*, 22, 94-107.
- RYAN, A. S., ZELLER, S. & NELSON, E. B. 2010. Safety evaluation of single cell oils and the regulatory requirements for use as food ingredients. *Single Cell Oils (Second Edition)*. Elsevier.
- SAHA, D. & MUKHERJEE, A. 2003. Pervasive computing: a paradigm for the 21st century. *Computer*, 36, 25-31.
- SAHA, D., MUKHERJEE, A. & BANDYOPADHYAY, S. 2011. *Networking infrastructure for pervasive computing: enabling technologies and systems*, Springer Science & Business Media.
- SAINSBURY, K., MULLAN, B. & SHARPE, L. 2013. Gluten free diet adherence in coeliac disease. The role of psychological symptoms in bridging the intention-behaviour gap. *Appetite*, 61, 52-58.
- SAKAI, R. & AERTS, J. Card Sorting Techniques for Domain Characterization in Problem-driven Visualization Research1. The Eurographics Association, 2015. 121-125.
- SALAMPASIS, M., TEKTONIDIS, D. & KALOGIANNI, E. P. 2012. TraceALL: a semantic web framework for food traceability systems. *Journal of Systems and Information Technology*, 14, 302-317.

- SAMAPUNDO, S., CLIMAT, R., XHAFFERI, R. & DEVLIEGHERE, F. 2014. Food safety knowledge, attitudes and practices of street food vendors and consumers in Port-au-Prince, Haiti. *Food Control*.
- SANCHEZ, M. E. 1992. Effects of Questionnaire Design on the Quality of Survey Data. *Public opinion quarterly*, 56, 206-217.
- SANDLIN, J. A. 2008. Consumption, Adult Learning, and Adult Education: Envisioning a Pedagogy of Consumption. *Part of the special issue on consumption*, 41, 47-62.
- SATYANARAYANAN, M. Fundamental challenges in mobile computing. Proceedings of the fifteenth annual ACM symposium on Principles of distributed computing, 1996. ACM, 1-7.
- SATYANARAYANAN, M. 2001. Pervasive computing: Vision and challenges. *IEEE Personal communications*, 8, 10-17.
- SAWTOOTH 2007. Maximum difference system: Technical paper. In: SOFTWARE, S. (ed.) *Sawtooth Software technical paper series*. 8 ed.
- SAWYER, A. G. 1973. The effects of repetition of refutational and supportive advertising appeals. *Journal of Marketing Research*, 23-33.
- SCHANK, R. C. & BERMAN, T. R. 2003. in Knowledge and Action. *Narrative impact: Social and cognitive foundations*, 287.
- SCHARFF, R. 2012. Economic burden from health losses due to foodborne illness in the United States. *J Food Prot.*
- SCHMIDT-WEIGAND, F. 2006. *Dynamic visualizations in multimedia learning: The influence of verbal explanations on visual attention, cognitive load and learning outcome*. Universitätsbibliothek Giessen.
- SCHMIDT-WEIGAND, F., KOHNERT, A. & GLOWALLA, U. 2010. Explaining the modality and contiguity effects: New insights from investigating students' viewing behaviour. *Applied Cognitive Psychology*, 24, 226-237.
- SCHOEN, C., OSBORN, R., SQUIRES, D., DOTY, M., RASMUSSEN, P., PIERSON, R. & APPLEBAUM, S. 2012. A survey of primary care doctors in ten countries shows progress in use of health information technology, less in other areas. *Health Affairs*, 31, 2805-2816.
- SCHRADER, P. G. & RAPP, E. E. 2016. Does Multimedia Theory Apply to all Students? The Impact of Multimedia Presentations on Science Learning. *Journal of Learning and Teaching in Digital Age (JOLTIDA)*, 1, 32-46.
- SCHROCK, A. R. 2015. Communicative affordances of mobile media: Portability, availability, locatability, and multimediality. *International Journal of Communication*, 9, 18.
- SCHULMAN, G. I. & WORRALL, C. 1970. Salience patterns, source credibility, and the sleeper effect. *Public opinion quarterly*, 34, 371-382.
- SCOTT, W., SCOTT, H., LAKE, R. & BAKER, M. 2000. Economic cost to New Zealand of foodborne infectious disease. *The New Zealand Medical Journal*, 113, 281-284.
- SECHREST, L. 1984. Reliability and validity. *Research methods in clinical psychology*, 24-54.
- SHACKLETON, M., SAFFRE, F., TATESON, R., BONSMAN, E. & ROADKNIGHT, C. 2004. Autonomic Computing for Pervasive ICT — A Whole-System Perspective. *BT Technology Journal*, 22, 191-199.
- SHEN, D. & LU, Z. 2006. Randomization in Clinical Trial Studies. Delaware, USA.: AstraZeneca Pharmaceuticals.

- SHERWOOD, N. E., STORY, M., NEUMARK-SZTAINER, D., ADKINS, S. & DAVIS, M. 2003. Development and implementation of a visual card-sorting technique for assessing food and activity preferences and patterns in African American girls. *Journal of the American Dietetic Association*, 103, 1473-1479.
- SHIM, S.-M., SEO, S. H., LEE, Y., MOON, G.-I., KIM, M.-S. & PARK, J.-H. 2011. Consumers' knowledge and safety perceptions of food additives: Evaluation on the effectiveness of transmitting information on preservatives. *Food Control*, 22, 1054-1060.
- SHOJANIA, K. G., MCDONALD, K. M., WACHTER, R. M. & OWENS, D. K. 2004. Toward a Theoretic Basis for Quality Improvement Interventions.
- SHUKLA, M. & JHARKHARIA, S. 2013. Agri-fresh produce supply chain management: a state-of-the-art literature review. *International Journal of Operations & Production Management*, 33, 114-158.
- SHUM, S. B. 1998. Negotiating the construction of organisational memories. *Information technology for knowledge management*. Springer.
- SILVERMAN, D. 2010. *Qualitative research*, Sage.
- SKÅR, R. 2010. Knowledge use in nursing practice: The importance of practical understanding and personal involvement. *Nurse Education Today*, 30, 132-136.
- SKARPHEDINSSON, G., WEIDLE, B., THOMSEN, P. H., DAHL, K., TORP, N. C., NISSEN, J. B., MELIN, K. H., HYBEL, K., VALDERHAUG, R. & WENTZEL-LARSEN, T. 2015. Continued cognitive-behavior therapy versus sertraline for children and adolescents with obsessive-compulsive disorder that were non-responders to cognitive-behavior therapy: a randomized controlled trial. *European child & adolescent psychiatry*, 24, 591-602.
- SLATER, M. D. 2002. Involvement as goal-directed strategic processing. *J. Dillard, & M. Pfau, The Persuasion Handbook: Developments in Theory and Practice*, 175-194.
- SLATER, P. E. 1958. Contrasting correlates of group size. *Sociometry*.
- SLOVIC, P. 1987. Perception of risk. *Science*, 236, 280-285.
- SLOVIC, P. 1992. Perception of risk: Reflections on the psychometric paradigm.
- SLOVIC, P., FISCHHOFF, B. & LICHTENSTEIN, S. 1980. Facts and fears: Understanding perceived risk. *Societal risk assessment*. Springer.
- SMITH, D. & RIETHMULLER, P. 1999. Consumer concerns about food safety in Australia and Japan. *International Journal of Social Economics*, 26, 724-742.
- SMITH, J. A. & OSBORN, M. 2003. Interpretative phenomenological analysis JA Smith (Ed.) *Qualitative Psychology A Practical Guide to Research Methods*. London: Sage Publications.
- SNEED, J., PHEBUS, R., DUNCAN-GOLDSMITH, D., MILKE, D., SAUER, K., ROBERTS, K. R. & JOHNSON, D. 2015. Consumer food handling practices lead to cross-contamination. *Food Prot. Trends*, 35, 36-48.
- SOLOMON, M. R., POLEGATO, R. & ZAICHKOWSKY, J. L. 2009. *Consumer behavior: buying, having, and being*, Upper Saddle River, NJ, Pearson Prentice Hall
- SONG, J., HUANG, J., CHEN, Y., ZHU, Y., LI, H., WEN, Y., YUAN, H. & LIANG, Y. 2015. The understanding, attitude and use of nutrition label among consumers (China). *Nutr Hosp*, 31, 2703-2710.
- SOO, C., DEVINNEY, T., MIDGLEY, D. & DEERING, A. 2002. Knowledge management: philosophy, processes, and pitfalls. *California management review*, 44, 129-150.

- SORDEN, S. D. 2012. *The cognitive theory of multimedia learning*, Charlotte, NC, Information Age Publishing.
- SPASSOVA, L., SCHÖNING, J., KAHL, G. & KRÜGER, A. Innovative retail laboratory. Roots for the Future of Ambient Intelligence. European Conference on Ambient Intelligence (AmI-09), 3rd, November, 2009. Citeseer, 18-21.
- SPENCER-OATEY, H. & FRANKLIN, P. 2012. What is culture. *A compilation of quotations. GlobalPAD Core Concepts*.
- STAFFORD, T. F., STAFFORD, M. R. & SCHKADE, L. L. 2004. Determining uses and gratifications for the Internet. *Decision sciences*, 35, 259-288.
- STAKE, R. E. 1995. *The art of case study research*, Sage.
- STANFORD, V. 2003. Pervasive computing goes the last hundred feet with RFID systems. *IEEE pervasive computing*, 2, 9-14.
- STEENKAMP, J.-B. E. 1997. Dynamics in consumer behavior with respect to agricultural and food products. *Agricultural marketing and consumer behavior in a changing world*. Springer.
- STENGER, K. M., RITTER-GOODER, P. K., PERRY, C. & ALBRECHT, J. A. 2014. A mixed methods study of food safety knowledge, practices and beliefs in Hispanic families with young children. *Appetite*, 83, 194-201.
- STILLER, K. D. 2007. Computerised multimedia learning. Modes of text presentation and access to text.
- STRAUS, S. E., TETROE, J. M. & GRAHAM, I. D. 2011. Knowledge translation is the use of knowledge in health care decision making. *Journal of clinical epidemiology*, 64, 6-10.
- STRAUSS, A. & CORBIN, J. 1994. Grounded theory methodology. *Handbook of qualitative research*, 273-285.
- STROBEL, J. & VAN BARNEVELD, A. 2009. When is PBL more effective? A meta-synthesis of meta-analyses comparing PBL to conventional classrooms. *Interdisciplinary Journal of Problem-based Learning*, 3, 4.
- SUDMAN, S. & BRADBURN, N. M. 1982. Asking questions: a practical guide to questionnaire design.
- SUNG, Y.-T., CHANG, K.-E., HOU, H.-T. & CHEN, P.-F. 2010. Designing an electronic guidebook for learning engagement in a museum of history. *Computers in Human Behavior*, 26, 74-83.
- SURESH, K. 2011. An overview of randomization techniques: an unbiased assessment of outcome in clinical research. *Journal of human reproductive sciences*, 4, 8.
- SWELLER, J. 1988. Cognitive load during problem solving: Effects on learning. *Cognitive Science*, 12, 257-285.
- SWIDLER, A. 2001. What anchors cultural practices. *The practice turn in contemporary theory*, 74-92.
- SZYMANSKI, D. M. & HISE, R. T. 2000. E-satisfaction: an initial examination. *Journal of retailing*, 76, 309-322.
- TABBERS, H. K. 2002. *The modality of text in multimedia instructions: Refining the design guidelines*, Open Universiteit.
- TABBERS, H. K., MARTENS, R. L. & VAN MERRIËNBOER, J. J. G. 2004. Multimedia instructions and cognitive load theory: Effects of modality and cueing. *British Journal of Educational Psychology*, 74, 71-81.
- TACHÉ, J. & CARPENTIER, B. 2014. Hygiene in the home kitchen: Changes in behaviour and impact of key microbiological hazard control measures. *Food Control*, 35, 392-400.

- TAINTER, C. R., WONG, N. L. & BITTNER, E. A. 2015. Innovative strategies in critical care education. *Journal of critical care*, 30, 550-556.
- TASHAKKORI, A. & CRESWELL, J. W. 2008. Editorial: Mixed methodology across disciplines. *Journal of mixed methods research*, 2, 3-6.
- TASHAKKORI, A. & TEDDLIE, C. 2003a. The past and future of mixed methods research: From data triangulation to mixed model designs. *Handbook of mixed methods in social and behavioral research*, 671-701.
- TASHAKKORI, A. & TEDDLIE, C. 2010. *Sage handbook of mixed methods in social & behavioral research*, Sage.
- TEDDLIE, C. & TASHAKKORI, A. 2003b. Major issues and controversies in the use of mixed methods in the social and behavioral sciences. *Handbook of mixed methods in social & behavioral research*, 3-50.
- TEDDLIE, C. & TASHAKKORI, A. 2006. A general typology of research designs featuring mixed methods. *Research in the Schools*, 13, 12-28.
- TEECE, D. J. 1998. Research directions for knowledge management. *California management review*, 40, 289.
- THAKUR, M. & DONNELLY, K. A.-M. 2010. Modeling traceability information in soybean value chains. *Journal of Food Engineering*, 99, 98-105.
- THORSON, K., DRISCOLL, K., EKDALE, B., EDGERLY, S., THOMPSON, L. G., SCHROCK, A., SWARTZ, L., VRAGA, E. K. & WELLS, C. 2013. YouTube, Twitter and the Occupy movement: Connecting content and circulation practices. *Information, communication & society*, 16, 421-451.
- TIOZZO, B., MARI, S., MAGAUDDA, P., ARZENTON, V., CAPOZZA, D., NERESINI, F. & RAVAROTTO, L. 2011. Development and evaluation of a risk-communication campaign on salmonellosis. *Food Control*, 22, 109-117.
- TOBIN, D., THOMSON, J. & LABORDE, L. 2012. Consumer perceptions of produce safety: A study of Pennsylvania. *Food Control*, 26, 305-312.
- TOCK, J. 2013. *Studying from the expert performance perspective: Reassessing how student time use is evaluated in the college student population*. The Florida State University.
- TOSSELL, C. C., KORTUM, P., SHEPARD, C., RAHMATI, A. & ZHONG, L. 2012. An empirical analysis of smartphone personalisation: measurement and user variability. *Behaviour & Information Technology*, 31, 995-1010.
- TRAFIMOW, D. & SNIEZEK, J. A. 1994. Perceived Expertise and Its Effect on Confidence. *Organizational behavior and human decision processes*, 57, 290-302.
- TRAUTH, E. M. 2001. *Qualitative research in international settings: Issues and trends*, IGI Global.
- TROCHIM, W. M. & DONNELLY, J. P. 2008. *Research methods knowledge base*, Atomic Dog/Cengage Learning Mason, OH.
- TROCHIM, W. M. K. 2006. The Research Methods Knowledge Base. Available: <http://www.socialresearchmethods.net/kb/>.
- TSAKIRIDOU, E., MATTAS, K., TSAKIRIDOU, H. & TSIAMPARLI, E. 2011. Purchasing Fresh Produce on the Basis of Food Safety, Origin, and Traceability Labels. *Journal of Food Products Marketing*, 17, 211-226.
- TUCKETT, A. G. 2005. Applying thematic analysis theory to practice: A researcher's experience. *Contemporary Nurse*, 19, 75-87.

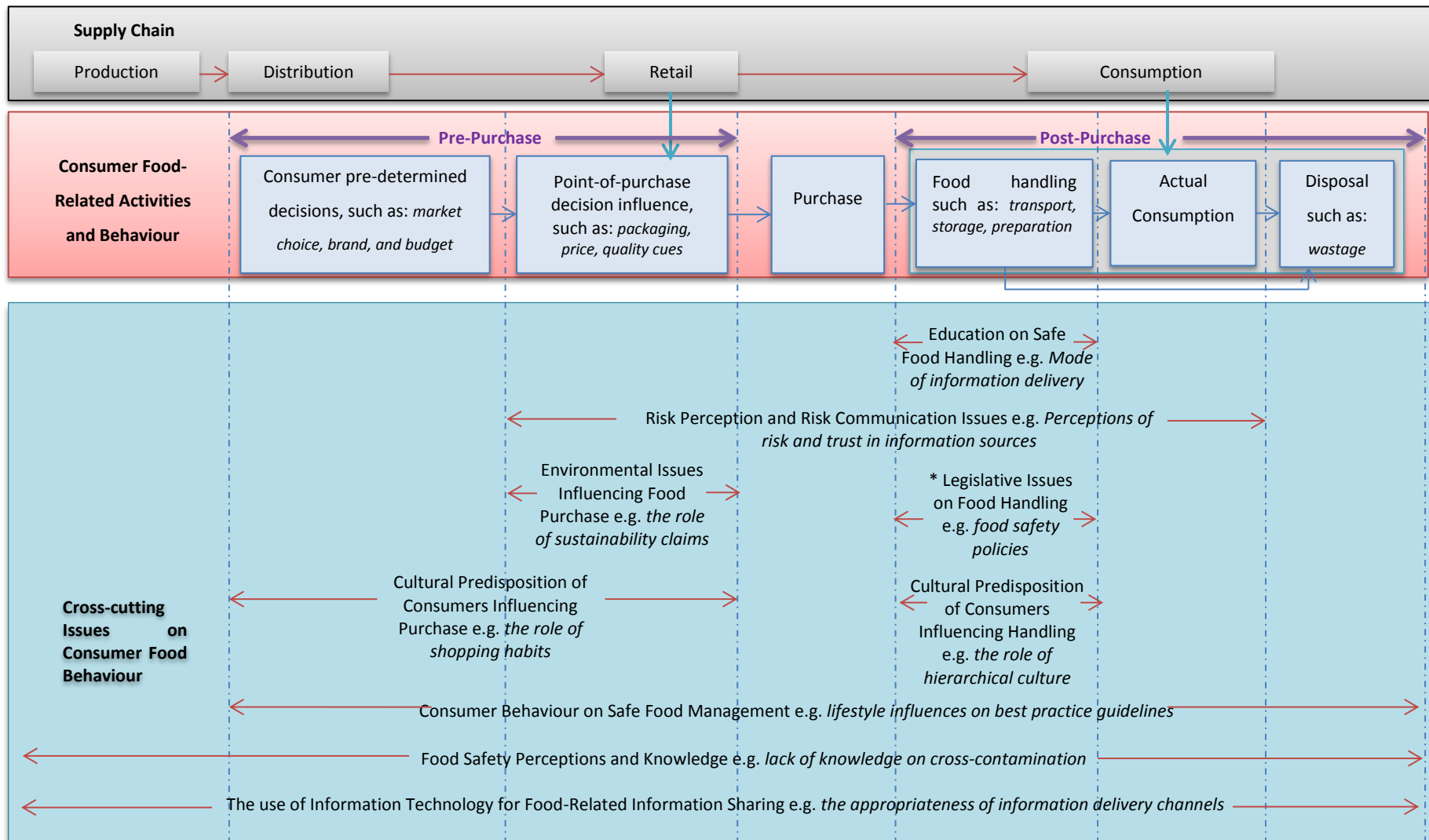
- TULLIS, T. & WOOD, L. E. How Many Users Are Enough for a Card-Sorting Study? Annual Meeting of the Usability Professionals Association, June 10-12 2004 Minneapolis.
- UN 2007. Safety and Quality of Fresh Fruit and Vegetables: A Training Manual for Trainers. In: NATIONS, U. (ed.). New York and Geneva.
- UNNEVEHR, L. J. & JENSEN, H. H. 1999. The economic implications of using HACCP as a food safety regulatory standard. *Food Policy*, 24, 625-635.
- URQUHART, C. 1999. *Themes and strategies in early requirements gathering: an investigation into analyst-client interaction*. University of Tasmania.
- URQUHART, C. 2000. An encounter with grounded theory: tackling the practical and philosophical issues. *Qualitative research in IS: Issues and trends*, 104-140.
- URQUHART, C. & FERNANDEZ, W. 2006. Grounded theory method: the researcher as blank slate and other myths.
- USDA. 2011. Food Safety Information. Available: https://www.fsis.usda.gov/shared/PDF/How_Temperatures_Affect_Food.pdf [Accessed 19/02/2018].
- USDA 2013a. The Big Thaw - Safe Defrosting Methods for Consumers. In: SERVICE, U. S. D. O. A.-F. S. A. I. (ed.).
- USDA 2013b. Leftovers and Food Safety. In: SERVICE, U. S. D. O. A.-F. S. A. I. (ed.).
- USDA. 2015. Beef from Farm to Table. Available: http://www.fsis.usda.gov/wps/portal/fsis/topics/food-safety-education/get-answers/food-safety-fact-sheets/meat-preparation/beef-from-farm-to-table/ct_index [Accessed 10/02/2016].
- VAN BOXSTAEL, S., DEVLIEGHERE, F., BERKVENS, D., VERMEULEN, A. & UYTENDAELE, M. 2014. Understanding and attitude regarding the shelf life labels and dates on pre-packed food products by Belgian consumers. *Food Control*, 37, 85-92.
- VAN DIJCK, J. 2008. Digital photography: communication, identity, memory. *Visual Communication*, 7, 57-76.
- VAN DORP, K.-J. 2003. Beef labelling: the emergence of transparency. *Supply Chain Management: An International Journal*, 8, 32-40.
- VAN LAER, T., DE RUYTER, K., VISCONTI, L. M. & WETZELS, M. 2013. The extended transportation-imagery model: A meta-analysis of the antecedents and consequences of consumers' narrative transportation. *Journal of consumer research*, 40, 797-817.
- VAN LOO, E. J., CAPUTO, V., NAYGA, R. M. & VERBEKE, W. 2014. Consumers' valuation of sustainability labels on meat. *Food Policy*, 49, 137-150.
- VAN RIJSWIJK, W. & FREWER, L. J. 2008. Consumer perceptions of food quality and safety and their relation to traceability. *British Food Journal*, 110, 1034-1046.
- VAN RIJSWIJK, W., FREWER, L. J., MENOZZI, D. & FAIOLI, G. 2008. Consumer perceptions of traceability: A cross-national comparison of the associated benefits. *Food Quality and Preference*, 19, 452-464.
- VAN TEIJLINGEN, E. & HUNDLEY, V. 2001. The importance of pilot studies. *Social research update*, Winter 2001, 1-4.
- VAN TRIJP, H. C. 2009. Consumer understanding and nutritional communication: key issues in the context of the new EU legislation. *European journal of nutrition*, 48, 41-48.
- VARZAKAS, T. H. 2011. Application of ISO22000, Failure Mode, and Effect Analysis (FMEA) cause and effect diagrams and Pareto in conjunction with HACCP and

- risk assessment for processing of pastry products. *Critical reviews in food science and nutrition*, 51, 762-782.
- VARZAKAS, T. H. & ARVANITOYANNIS, I. S. 2008. Application of ISO22000 and comparison to HACCP for processing of ready to eat vegetables: Part I. *International journal of food science & technology*, 43, 1729-1741.
- VASILEIOU, K. & MORRIS, J. 2006. The sustainability of the supply chain for fresh potatoes in Britain. *Supply Chain Management: An International Journal*, 11, 317-327.
- VENKATESH, V., BROWN, S. A. & BALA, H. 2013. Bridging the qualitative-quantitative divide: Guidelines for conducting mixed methods research in information systems. *MIS quarterly*, 37, 21-54.
- VERBEKE, W. & DE BOURDEAUDHUIJ, I. 2007. Dietary behaviour of pregnant versus non-pregnant women. *Appetite*, 48, 78-86.
- VERBEKE, W., FREWER, L. J., SCHOLDERER, J. & DE BRABANDER, H. F. 2007. Why consumers behave as they do with respect to food safety and risk information. *Analytica Chimica Acta*, 586, 2-7.
- VERBEKE, W., SCHOLDERER, J. & LÄHTEENMÄKI, L. 2009. Consumer appeal of nutrition and health claims in three existing product concepts. *Appetite*, 52, 684-692.
- VERBEKE, W. & WARD, R. W. 2006. Consumer interest in information cues denoting quality, traceability and origin: An application of ordered probit models to beef labels. *Food Quality and Preference*, 17, 453-467.
- VERKASALO, H., LÓPEZ-NICOLÁS, C., MOLINA-CASTILLO, F. J. & BOUWMAN, H. 2010. Analysis of users and non-users of smartphone applications. *Telematics and Informatics*, 27, 242-255.
- VERKASOLO, M. & LAPPALAINEN, P. 1998. A method of measuring the efficiency of the knowledge utilization process. *IEEE Transactions on Engineering Management*, 45, 414-423.
- WAJCMAN, J., BITTMAN, M. & BROWN, J. E. 2009. Intimate connections: The impact of the mobile phone on work/life boundaries.
- WALSHAM, G. 1995. Interpretive case studies in IS research: nature and method. *European Journal of information systems*, 4, 74-81.
- WANG, C.-Y., TSAI, M.-J. & TSAI, C.-C. 2016. Multimedia recipe reading: Predicting learning outcomes and diagnosing cooking interest using eye-tracking measures. *Computers in Human Behavior*, 62, 9-18.
- WANG, H. H., ZHANG, X., ORTEGA, D. L. & OLYNK WIDMAR, N. J. 2013. Information on food safety, consumer preference and behavior: The case of seafood in the US. *Food Control*, 33, 293-300.
- WANSINK, B., TAL, A. & BRUMBERG, A. 2014. Ingredient-based food fears and avoidance: Antecedents and antidotes. *Food Quality and Preference*, 38, 40-48.
- WATSON, R., GEE, A., POLKINGHORNE, R. & PORTER, M. 2008. Consumer assessment of eating quality—development of protocols for Meat Standards Australia (MSA) testing. *Animal Production Science*, 48, 1360-1367.
- WEBER, V., WHITE, A. & MCILVRIED, R. 2008. An electronic medical record (EMR)-based intervention to reduce polypharmacy and falls in an ambulatory rural elderly population. *Journal of general internal medicine*, 23, 399-404.
- WEDEL, M., KAMAKURA, W. & BÖCKENHOLT, U. 2000. Marketing data, models and decisions. *International Journal of Research in Marketing*, 17, 203-208.
- WEISER, M. 1991. The computer for the 21st century. *Scientific american*, 265, 94-104.

- WENSING, M., BOSCH, M., FOY, R., VAN DER WEIJDEN, T., ECCLES, M. & GROL, R. 2005. Factors in theories on behaviour change to guide implementation and quality improvement in healthcare. *Nijmegen: Centre for Quality of Care Research (WOK)*.
- WERTHEIM-HECK, S. C. O., SPAARGAREN, G. & VELLEMA, S. 2014. Food safety in everyday life: Shopping for vegetables in a rural city in Vietnam. *Journal of Rural Studies*, 35, 37-48.
- WESLEY BURGESS, J. 1984. Do humans show a “species-typical” group size?: Age, sex, and environmental differences in the size and composition of naturally-occurring casual groups. *Ethology and Sociobiology*, 5, 51-57.
- WHO 2002. WHO global strategy for food safety: Safer food for better health. In: DEPARTMENT, F. S. (ed.). Geneva, Switzerland: World Health Organization.
- WHO 2015. Food Safety - Fact Sheet No 399.
- WIIG, K. M. 1997. Knowledge management: Where did it come from and where will it go? *Expert Systems with Applications*, 13, 1-14.
- WIIG, K. M. 1999. Introducing knowledge management into the enterprise. *Knowledge management handbook*, 119-158.
- WILLIAMS, P., STIRLING, E. & KEYNES, N. 2004. Food fears: a national survey on the attitudes of Australian adults about the safety and quality of food. *Asia Pacific Journal of Clinical Nutrition*, 13, 32-39.
- WILSON, M. W. 2012. Location-based services, conspicuous mobility, and the location-aware future. *Geoforum*, 43, 1266-1275.
- WILSON, T. 1989. Towards an information management curriculum. *Journal of Information Science*, 15, 203-209.
- WILSON, T. D. 1999. Models in information behaviour research. *Journal of Documentation*, 55, 249-270.
- WIMBERLEY, S. L. & MCCLEAN, J. L. 2012. Supermarket savvy: The everyday information-seeking behavior of grocery shoppers. *Information & Culture*, 47, 176-205.
- WINTERS, N. 2007. What is mobile learning. *Big issues in mobile learning*, 7-11.
- WONG, H. R. & SAN HU, J. 2011. Why Do People Hesitate? Perceived Risk in Workplace Spirituality. *International journal of business and management*, 6, p57.
- WONG, L., SELVANANTHAN, E. & SELVANANTHAN, S. 2013. Changing Pattern of Meat Consumption in Australia. Griffith Business School, May.
- WONG, L. P. 2008. Focus group discussion: a tool for health and medical research. *Singapore Med J*, 49, 256-60.
- WONG, W. & RADCLIFFE, D. F. 2000. The tacit nature of design knowledge. *Technology Analysis & Strategic Management*, 12, 493-512.
- WOOD, J. R. & WOOD, L. E. 2008. Card sorting: current practices and beyond. *Journal of Usability Studies*, 4, 1-6.
- WOODS, M. & ROSENBERG, M. E. 2015. Educational Tools: Thinking Outside the Box. *Clinical Journal of the American Society of Nephrology*, CJN. 02570315.
- WORSLEY, A., WANG, W., ISMAIL, S. & RIDLEY, S. 2014. Consumers' interest in learning about cooking: the influence of age, gender and education. *International Journal of Consumer Studies*, 38, 258-264.
- WU, C.-S., CHENG, F.-F. & YEN, D. C. 2008. The atmospheric factors of online storefront environment design: an empirical experiment in Taiwan. *Information & Management*, 45, 493-498.

- WU, L., ZHONG, Y., SHAN, L. & QIN, W. 2013. Public risk perception of food additives and food scares. The case in Suzhou, China. *Appetite*, 70, 90-98.
- WYND, C. A., SCHMIDT, B. & SCHAEFER, M. A. 2003. Two quantitative approaches for estimating content validity. *Western Journal of Nursing Research*, 25, 508-518.
- YACOBUCCI, M. M. 2012. Using Active Learning Strategies to Promote Deep Learning in the Undergraduate Paleontology Classroom. *The Paleontological Society Special Publications*, 12, 135-154.
- YAN, T., CHU, D., GANESAN, D., KANSAL, A. & LIU, J. Fast app launching for mobile devices using predictive user context. Proceedings of the 10th international conference on Mobile systems, applications, and services, 2012. ACM, 113-126.
- YE, J., DOBSON, S. & MCKEEVER, S. 2012. Situation identification techniques in pervasive computing: A review. *Pervasive and mobile computing*, 8, 36-66.
- YELLAND, N., COPE, B. & KALANTZIS, M. 2008. Learning by design: Creating pedagogical frameworks for knowledge building in the twenty-first century. *Asia-Pacific Journal of Teacher Education*, 36, 197-213.
- YEUNG, R. M. & MORRIS, J. 2001. Food safety risk: Consumer perception and purchase behaviour. *British Food Journal*, 103, 170-187.
- YIN, R. K. 1989. *Case study research: Design and methods*, sage.
- YOO, Y. 2010. Computing in everyday life: A call for research on experiential computing. *MIS quarterly*, 213-231.
- YOUNG, J. Q., VAN MERRIENBOER, J., DURNING, S. & TEN CATE, O. 2014. Cognitive load theory: Implications for medical education: AMEE guide no. 86. *Medical teacher*, 36, 371-384.
- ZAJONC, R. B. 1968. Attitudinal effects of mere exposure. *Journal of Personality and Social Psychology*, 9, 1.
- ZHAO, Y. & ZHANG, J. 2017. Consumer health information seeking in social media: a literature review. *Health Information & Libraries Journal*.
- ZIMMERMAN, D. E. & AKERELREA, C. A group card sorting methodology for developing informational web sites. Professional Communication Conference, 2002. IPCC 2002. Proceedings. IEEE International, 2002. IEEE, 437-445.
- ZYDNEY, J. M. & WARNER, Z. 2016. Mobile apps for science learning: Review of research. *Computers & Education*, 94, 1-17.

10 APPENDIX A - PERSPECTIVES ON CONSUMER FOOD BEHAVIOUR ISSUES: A CONCEPTUAL MAP



11 APPENDIX B - POSTER ADVERT FOR EXPERIMENT PARTICIPANT RECRUITMENT



AN INVITATION TO PARTICIPATE IN FOOD SAFETY RESEARCH

Research Topic: An Investigation into Food Safety Knowledge Optimization in relation to Consumers' Food Management Behaviours

My research is based on a user-led design of a food safety mobile phone application which has just been developed. Through 4 learning sessions, I will like to know if this app helps you understand how food should be safely handled in your home. The insight you provide, through our questionnaires, has the potential to influence recommendations that will be presented to government authorities, on the completion of this study.



Please be invited to participate if you fit the following criteria;

1. An Australian adult (18 years and above).
2. Someone who purchases, cooks and eats red meat.
3. Someone who has a smart phone and an earpiece, specifically an *android 4.0.3* or an *iPhone 4 and newer versions*.
4. Someone who will be available in the evenings for an initial two hour session and subsequently 3 one hour sessions across a period of 5 weeks.

What you will gain;

- An intensive workshop on food safety in the home
- First-hand access to the first Australian Meat Safety App
- Nibbles and drinks in every session for refreshment
- A \$50 cash gift to compensate for your valuable time on completion of the last session.

12 APPENDIX C – PRE-TEST BASELINE QUESTIONNAIRE

Baseline Questionnaire on Safe Food Management

Practices

Name:

Group Name:

Instructions

- There are 20 questions and you are expected to answer all questions to the best of your knowledge.
- Please circle whichever option you think is most correct.
- Please note that this is an individual task.
- Please note that you are not allowed to use any learning material or resource to answer the questions.
- Please read through the following questions and answer them as best as you can.

1. The microorganisms that cause most food-borne illnesses are:
 - a. Bacteria
 - b. Viruses
 - c. Parasites
 - d. Fungi
2. Of the following, which do you think is the right way to check that a hamburger is sufficiently cooked?
 - a. By checking the colour
 - b. By checking the firmness
 - c. By measuring the temperature at the center
 - d. By checking the cooking time
3. Which is the most important for preventing food poisoning?
 - a. Spray the kitchen with insecticides weekly
 - b. Avoid eating leftovers
 - c. Keep food refrigerated until it's time to serve them
 - d. Use detergent to disinfect kitchen countertop or stove weekly

4. Of the following, which is the right way to heat leftovers?
- Until they are steaming hot
 - Just until they are hot, but not too hot to eat right away
 - Just until they are at least at room temperature
 - Reheating is not necessary if its during summer
 - Heat it to the temperature you prefer
5. For a burger to be safe to eat, it needs to be cooked until its internal temperature reaches:
- 52 °C
 - 60 °C
 - 75 °C
 - 82 °C
 - Don't know
6. Which of these individuals should NOT prepare food for other people?
- A person with diarrhea
 - A person with severe acne
 - A person with HIV
 - A person with a cold
7. What should be done with prepared food that will be consumed 3 hours later?
- Put it in the refrigerator, then reheat when ready to eat it
 - Put it on the kitchen counter, then reheat when ready to eat it
 - Put it in the microwave oven
 - Cover it and put it in a kitchen cabinet
 - Cover it and place it on the bench top
8. A person has cut meat on a chopping board with a knife and now he/she wants to cut fruit. The next steps the person may take includes:
- Choice 1: Use the board and knife as they are
- Choice 2: Wipe the board and knife off with a paper towel before cutting fruit
- Choice 3: Rinse the board and knife with hot water before cutting fruit
- Choice 4: Wash the board and knife with soap and water before cutting fruit
- Choice 5: Use a different board and a different knife to cut fruit
- Choice 6: Use the other side of the board and a different knife to cut fruit
- Choice 7: Wash the board and knife with soap and hot water before cutting fruit

To prevent cross-contamination, which of the aforementioned choices do you regard as the best?

- a. Choice 1 only
- b. Choice 1 or 2
- c. Choice 3 or 4
- d. Choice 4 or 7
- e. Choice 5 or 6
- f. Choice 5 or 7
- g. Some other combination of choices

9. How should you wash your hands before cooking or eating?

- a. Ordinary soap and water
- b. Water only
- c. Wipe with a towel or dish cloth
- d. Hand sanitizer
- e. I do not wash my hands

10. Washing dishes may include:

Choice 1: wash and dry them in an automatic dishwasher,

Choice 2: soak them in the sink for several hours and then wash them in the same water,

Choice 3: hand-wash them right after the meal and then let them air-dry,

Choice 4: hand-wash them right after the meal and then dry them with a dishtowel.

To prevent food poisoning, which of the aforementioned choices do you regard as the best?

- a. Choice 1 or 2
- b. Choice 1 or 3
- c. Choice 2 or 4
- d. Choice 3 or 4
- e. All of the above

11. In the kitchen, how should you dry your hands after washing them?

- a. Paper towel
- b. Hot air electrical dryer

- c. You leave them to dry on their own
- d. Your clothes/apron
- e. Baby wipes

12. While washing your hands, it is recommended to rub them for?

- a. 10s
- b. 20s
- c. 30s
- d. 40s

13. After touching which of the following **must** a person wash his/her hands during the course of preparing food.

Choice 1: Face

Choice 2: Fresh fruits

Choice 3: Pimple on surface of the skin

Choice 4: Clothes

Choice 5: Clean dishes

- a. Choice 1 and 4
- b. Choice 2 and 3
- c. Choice 1 and 3
- d. Choice 4 and 5
- e. Choice 2 and 5

14. Most disease-causing bacteria can grow within a temperature range between:

- a. $0^{\circ}\text{C} - 40^{\circ}\text{C}$
- b. $4^{\circ}\text{C} - 60^{\circ}\text{C}$
- c. $10^{\circ}\text{C} - 40^{\circ}\text{C}$
- d. $20^{\circ}\text{C} - 60^{\circ}\text{C}$
- e. $30^{\circ}\text{C} - 70^{\circ}\text{C}$

15. What is the recommended temperature for freezers?

- a. -18°C
- b. 18°C
- c. 8°C
- d. 0°C
- e. 3°C

16. What is the recommended temperature for fridges?

- a. -18°C
- b. -4°C
- c. 4°C
- d. 7°C

e. 12 °C

17. Freezing kills harmful germs in food.

- a. True
- b. False

18. How should chunks of raw meat be stored in a freezer?

- a. Store it directly in the refrigerator
- b. Slice it into smaller pieces, then store them in the refrigerator
- c. Slice into smaller pieces, seal and store them in refrigerator
- d. Store it in a cool place

19. If necessary, how long should cooked meat be left to cool on a benchtop prior to refrigeration?

- a. Not more than 1 hour
- b. Between 1 hour and 2 hours
- c. Between 2 hours and 3 hours
- d. Till it is completely cool
- e. I don't know

20. Below are some choices on different considerations for the most appropriate method of food storage in the refrigerator:

Choice 1: Cover all cooked food

Choice 2: Place cooked food on a shelf below raw meat

Choice 3: Place cooked food on a shelf above raw meat

Choice 4: Place covered raw meat next to covered cooked food

Choice 5: Place raw meat in the coldest part of the refrigerator

Choice 6: Store food with strong odours with cling wrap

Choice 7: Store food with strong odours with closed glass or plastic containers

Of the aforementioned choices, which ones would you consider as the best practices?

- a. Choice 1, 2 and 6 only
- b. Choice 1, 4 and 7 only
- c. Choice 1, 3 and 6 only
- d. Choice 1, 3, 5 and 7
- e. Choice 1, 2, 5 and 6
- f. Choice 1, 3, 5 and 6
- g. Choice 1, 4, 5 and 6
- h. Choice 1, 2, 5 and 7
- i. Some other combination

13 APPENDIX D - SCENARIO BASED QUESTIONS (POST-TEST 2)

Safe Food Management Practices

Name:

Group Name:

There are two sections (A and B). Please read through the instructions for each section before you proceed.

Instructions for Section A

- There are 8 questions, please read through and answer them as best as you can.
- Please circle **ONLY ONE** option which you think is most applicable to you, unless it is clearly specified that you can circle multiple options.
- Please note that this is an individual task.

Section A

1. Between the last learning session and now, did you revise the learning resource (app or document) you were given?
 - a. Yes
 - b. No
2. If applicable, how many times did you revise the learning resource?
 - a. Once
 - b. Twice
 - c. 3 times
 - d. 4 times
 - e. 5 or more times
 - f. Not applicable
3. For each time you revised the learning resource, how long did you typically spend revising?
 - a. Less than 5 minutes
 - b. Between 5 and 10 minutes
 - c. Between 10 and 15 minutes
 - d. Between 15 and 30 minutes
 - e. More than 30 minutes
 - f. Not applicable
4. Did you share what you learnt during the last learning session with anyone?
 - a. Yes
 - b. No
5. If applicable, how did you share the knowledge you gained during the last learning session?

For this question only, you can select multiple options.

- a. By discussing about it
 - b. By correcting someone's food handling practice
 - c. By sharing it on social media
 - d. Through other means (please specify)
 - e. Not applicable
6. Have you ever learnt to cook any meal through a recipe resource (e.g. recipe booklet, online recipes, TV shows, friends & family etc.)
- a. Yes
 - b. No

7. If applicable, which of the following recipe resources have you ever used?

For this question only, you can select multiple options.

- a. Recipe books
 - b. Online recipes
 - c. TV shows
 - d. Cooking classes
 - e. Friends & family
 - f. Through other means (please specify)
 - g. Not applicable
8. If applicable, how many times do you think you have learnt to cook a meal from a recipe resource?
- a. Less than 5 times
 - b. Between 5 and 10 times
 - c. Between 10 and 20 times
 - d. More than 20 times
 - e. Not applicable

Instructions for Section B

- There are only 4 questions and you are expected to answer all questions to the best of your knowledge.
- Please read through the following scenario based questions and answer them as best as you can.
- **Please explain all your answers clearly and the reasons for your answers.**
- Please provide your answers in the boxes provided below the questions.
- Please note that this is an individual task.
- **Please note that you are not allowed to use any learning material or resource to answer the questions.**

Section B

Question 1 - This question has only 1 context.

Context for Question 1 – Recipe for Lamb chops with Greek fattoush salad

Source -

<http://www.taste.com.au/recipes/41607/lamb+chops+with+greek+fattoush+salad?ref=weeknightinspiration>

Please take only a few minutes to glance through the recipe



Ingredients

1/4 cup (60ml) olive oil
2 garlic cloves, crushed
1/4 cup fresh oregano, finely chopped
1 lemon, zested and juiced
1 tablespoons red wine vinegar
8 (800g) Australian lamb loin chops
1 large pita bread
Olive oil, extra, to brush
350g mixed medley tomatoes, halved
1/2 red onion, thinly sliced
1/2 cup pitted kalamata olives
1 Lebanese cucumber, coarsely chopped
1/3 cup fresh oregano, extra
150g Greek feta, diced
Lemon wedges, to serve

Method of Preparation

Step 1: Combine oil, garlic, oregano, lemon zest and juice, and red wine vinegar in a jug. Season. Place the chops in a glass or ceramic dish. Pour over 2/3 of the marinade. Set aside for 15 mins to marinate.

Step 2: Meanwhile, preheat oven to 180C. Brush pita bread with oil on both sides. Place on a lined baking tray. Bake for 5-8 mins or until crisp. Set aside to cool slightly.

Step 3: Place the tomato, onion, olives, cucumber, extra oregano and feta in a large bowl. Coarsely break the pita bread and add to bowl. Drizzle with remaining marinade, season and toss to coat.

Step 4: Heat a barbecue or chargrill on medium heat. Cook chops for 3 mins each side. Cover and set aside for 5 mins to rest. Serve chops with the salad and lemon wedges.

Scenario 1

You are in the process of preparing Lamb chops with Greek fattoush salad. You have used a knife and a chopping board to trim the edges of each piece of Lamb to ensure perfection before placing them in a ceramic dish as stated in Step 1. You have carried out step 2. However, you cannot carry out step 3 because you have not chopped the tomatoes, onions and cucumber.

Question 1

Clearly describe **2 different methods** of avoiding cross contamination between the raw lamb chops and the vegetables. *Please explain clearly and in detail.*

Question 2 – This question has only 1 context.

Context for Question 2 – Recipe for Ginger Maple Pork Steak

Source - <http://www.pork.com.au/home-page-consumer/recipes/recipe-finder/Ginger-maple-pork-steak.aspx>

Please take only a few minutes to glance through the recipe



Ingredients

- 4 lean pork medallions or scotch fillet steaks
- 2 cm fresh ginger, peeled and grated
- 100 mL green ginger wine
- 2 tblsp olive oil
- ¼ cup maple syrup
- ½ cup maple syrup, extra
- Crispy roast potatoes to serve
- Salad to serve

Method of Preparation

Step 1: Trim pork and place in a shallow non-metallic dish. Whisk together ginger, green ginger wine, olive oil and maple syrup and pour over the pork steaks. Allow to marinate for up to 4 hours, turning frequently.

Step 2: Pre-heat a pan, griddle pan or BBQ to a medium-high heat.

Step 3: Cook the steaks for 6 minutes on one side without turning. Turn over once and cook for a further 2 minutes.

Step 4: Remove steaks from the heat and rest for 2 minutes before serving.

5. Serve drizzled with a little maple syrup, crispy roast potatoes and green salad.

Scenario 2

You have prepared Ginger Maple Pork Steak for a few friends. One of them just rang you telling you he will be 3 hours late due to circumstances beyond his control.

Question 2

Clearly describe **all** the steps you would take to preserve the meal till your friend arrives and is ready to eat. *Please explain clearly and in detail.*

Question 3 – This question has 2 different contexts.

Context 1 for Question 3 – Recipe for Bacon Cheese and Avocado Sandwich

Source -

<http://www.taste.com.au/recipes/8056/bacon+tomato+and+avocado+jaffles?ref=collections>

Please take only a few minutes to glance through the recipe



Ingredients

250g bacon, rind removed, cut into thirds
olive oil cooking spray
8 thick slices multigrain bread
2 tomatoes, thinly sliced
1 ripe avocado, peeled, thinly sliced
100g cheddar cheese, grated

Method of Preparation

Step 1: Preheat a sandwich press. Heat a frying pan over medium heat. Cook bacon for 6 minutes, turning, or until crispy. Drain.

Step 2: Spray oil over 1 side of 4 slices of bread. Place onto a flat surface, oil-side down. Top with bacon, tomato, avocado and cheese. Season with salt and pepper. Top with remaining bread slices. Spray with oil.

Step 3: Place sandwiches, 2 at a time, into sandwich press. Cook for 6 minutes or until golden. Serve.

Context 2 for Question 3

Dinner Idea – Pan-Fried Chicken with Silverbeet and Pumpkin Mash

Core Ingredient – Chicken Breasts



Scenario 3

You have just had Bacon cheese and avocado sandwich for lunch at your dining table. However, you have leftovers of the meal.

Also, you are planning to make Pan-Fried Chicken with Silverbeet and Pumpkin Mash for dinner and you have just bought the chicken breasts from your butcher. The raw chicken is placed on your kitchen benchtop as shown above. However, you need to store the raw chicken in your fridge for the next 5 hours (till it is time to make dinner).

Question 3

Clearly describe **all** the steps you would take to store the leftover lunch and the raw chicken in your fridge while ensuring the safety of the leftover. *Please explain clearly and in detail.*

Question 4 – This question has only 1 context.

Context for Question 4 – Recipe for Spinach Lamb Wraps

Source - <http://www.taste.com.au/recipes/25234/spinach+lamb+wraps>

Please take only a few minutes to glance through the recipe



Ingredients

500g lamb rump steaks, fat trimmed, thinly sliced
35g pkt taco seasoning
Olive oil spray, to grease
4 Mission Garden Spinach & Herb Wraps
2 x 70g pkts Baby Leaves with Beetroot salad mix

Method of Preparation

Step 1: Place the lamb and seasoning in a bowl and toss to coat.

Step 2: Spray a non-stick frying pan with oil. Heat over medium heat. Cook one-third of the lamb for 1-2 minutes or until tender. Transfer to a plate. Repeat, in 2 more batches, with remaining lamb.

Step 3: Place 1 wrap on a clean work surface. Place one-quarter of the salad mix along the centre. Top with one-quarter of the lamb. Roll up firmly to enclose the filling. Repeat with the remaining wraps, salad mix and lamb to make 4 wraps. Cut each wrap in half crossways.

Scenario 4

You are preparing spinach lamb wraps. You have completed steps 1 and 2 and you are in the middle of step 3. You have placed the filling on the wrap and you are **about to** roll it up. However, your kitchen knife fell on the floor. You quickly picked up the knife and placed it in the sink, to be washed later, as you will be using a different knife to cut the wrap. At this stage, you realised that your hands have touched the floor and you cannot roll the wrap unless your hands are clean.

Question 4

Clearly describe **all** the steps you would take to ensure your hands are clean before you roll the wraps. *Please explain clearly and in detail.*

Thanks for your participation today.

14 APPENDIX E – SCENARIO BASED QUESTIONS (POST-TEST 3)

Food Safety Research – Session 4

Name:

Instructions

1. Please read through the following questions and try to apply the knowledge you have gained within the past 4 weeks.
2. There are 4 questions and each question will be answered at a different table. You are required to move to the next table to complete each task.
 - a. If you are starting from Table A, you will move to Table B.
 - b. From Table B, you will move to Table C and from Table C to Table D.
3. Once you complete your task at each table please step aside to signify that you are ready to move to the next table.
4. After stepping aside, please do not approach the next table unless the occupant has stepped aside. This is important because we do not want anyone to feel rushed. Therefore, you are encouraged to take your time but try not to spend more than 10 minutes on each question.
5. Please note that you have to **critically look** at all the items presented to you before you decide on how to answer the questions.
6. Please note that this is an individual task.
7. Please note that it is important to clearly explain your answer **and** the reason for your answer in details.
8. *You have been given a pair of gloves because one of the 4 questions (related to cooked food) may require you to use the gloves.*
9. *For any question that relates to the use of a fridge, you are allowed to open the fridge and assess the contents.*
10. *For the remaining two questions, you do not need to touch anything. However, you need to critically look at the items.*

TABLE A

Question 1 – Critically examine Table A

You want to use the knife and chopping board to cut the snow peas, tomatoes and the onions. Clearly describe all the steps you will take to ensure you avoid cross contamination.

- *Please provide a minimum of 4 steps.*
- *Please discuss only one method, based on the materials available to you in the context provided.*

--

TABLE B

Question 2 – Critically examine Table B and read through the information provided about the chicken

- a. Is it safe to eat the chicken?
- b. Why? (Please provide a minimum of 2 reasons for your answer)

--

TABLE C

Question 3 – Critically examine Table C

- a. You have finished cutting the pork into smaller pieces. You have washed your hands with warm soapy water for 30 seconds and you have perfectly dried your hands with the kitchen towel on the table. Have you cleaned your hands in accordance with best practice guidelines?
- b. Please give a significant reason to justify your answer in “a” above.

--

TABLE D

Question 4 – Critically examine the fridge at station D

- a. Examine the fridge, the container labelled “uncooked premium Tasmanian salmon” and the container labelled “garden salad”. Is the storage arrangement of those 2 items in accordance with best practice?
- b. Please give a minimum of 4 reasons to justify your answer in “a” above.

Please note that this fridge is usually used in a commercial setting, such as a professional chef’s kitchen. Therefore, it does not have the basic configuration of a domestic fridge. However, the most important information is that the internal temperature in the fridge is equal for all parts in the fridge.

--

15 APPENDIX F – PRELIMINARY STAGE, PHASE ONE INTERVIEW QUESTIONS

1. Background information about the organisation
 - a. Can you please discuss the transformation process of your products from the farm to the consumers' table?
 - b. Can you please discuss about your interactions with your supply chain partners?
 - c. Can you please discuss the level of information technology usage in your firm? (tools, applications etc.)
 - d. Can you please discuss about food safety management in your firm? (systems, process, risk assessments etc.)
2. Questions about customer/consumer interactions with the firm
 - a. What communication methods does the firm currently have with their end-consumers? (How do you receive feedbacks from your consumers? Do you have any way to contact / pass across information to your consumers? How do you achieve that?)
 - b. How does the firm classify their consumers?
3. Questions about other types of information that may influence consumer confidence.
 - a. What attributes of your product packaging influences your end-consumers?
 - b. How does your brand positioning influence your end-consumers?
 - c. How do you gather and utilise market intelligence?
4. Questions about information and knowledge flows in relation to the recall situation.
 - a. What information was provided to the consumers immediately the recall incident occurred?
 - b. What information was provided to the consumers after the safety situation was rectified?
 - c. What information should have been provided?
5. Questions about the recall incident
 - a. What impact has the recall incident had on the firm?
 - b. What could have been done better?

16 APPENDIX G – AN EXAMPLE OF A FIELD NOTE

Date	1 st July 2014
Place	The Location of the Food Firm
Time	09:10
Topic	Food Recall Incident and Consumers
Participants	Adeola Bamgboje, Participant 001, Participant 001's husband
Content	<p>The introduction took place in the participant's office. The participant asked for the list of questions first before the discussion commenced but once the interview started, questions that were not necessarily in the prior list were asked. The discussion started with the participant initially, but the participant's husband later came in. During the interview, the participant disagreed with a comment her husband made only on one issue, which concerned consumer's perception concerning the recall. The participant's husband tried to downplay the impact on the customers, while the participant disagreed in a subtle manner. All the questions were clear to the participant and no further clarification was needed. The participant offered detailed answers to the questions and the interview lasted 5 hours. The participant took notes concerning lessons learnt and the issues requiring attention in her business.</p>
Personal Notes	<p>The participant illustrated that she particularly prefers mobile phone applications to websites because she was generally a busy person. She emphasised that that is the reason why she prefers twitter as it provides the required information in seconds. She illustrated a scenario of a mother in the kitchen, who is saddled with a lot of responsibilities, and that it will be difficult for the woman to be looking at a website for safety and quality information on a certain food she is about to prepare. She however made the comment that, some of her consumers prefer the detailed information in her website but she would not like to lose any of them. The participant also mentioned that it was likely Tony Abbot's budget, the holiday period, the weather change and tacit knowledge loss had some influence on the impact of the incident.</p>

17 APPENDIX H – ADVANCED STAGE, PHASE ONE – CONSUMER SURVEY

Jump to pageCustomizeRestore

Page 1: Informed Consent

Thank you for your interest in our study. Please read the following information carefully before you proceed.

Investigators: Dr. Leonie Ellis, Associate Prof. Paul Turner, Adeola Bamgboje

Research Study: An investigation into consumers' safe food management behaviours post-purchase.

Description of Research: This research aims to explore consumer attitudes and behaviours concerning the safe management of food products post-purchase (handling, storage, transportation, preparation, disposal). To do this, the research needs insight into your practices in relation to food handling and other food management related information. In order to participate in this study, you must meet our selection criteria. Once you agree to participate, you will be asked a few questions to determine if you meet our selection criteria.

Risks and Benefits: There are no anticipated risks that may arise from participating in this study. It is anticipated that your participation will greatly benefit the wider Australian community as a whole. This research provides an improved way of providing food safety information to consumers.

Time Involvement: Your participation will take approximately 10 - 15 minutes.

Questions or Complaints: Please note that all information will be treated in a confidential manner. If you have enquiries regarding this study, please contact Adeola Bamgboje at Adeola.Bamgboje@utas.edu.au or Dr. Leonie Ellis at Leonie.Ellis@utas.edu.au. This study has been approved by the Tasmanian Social Sciences Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study, please contact the Executive Officer of the HREC (Tasmania) Network on +61 3 6226 7479 or email human.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. Please quote ethics reference number [H0014658].

Clicking "I agree" below indicates that you are willing to participate.

I have read the information above and *This question is required.

☐ I agree to participate

☐ I do not agree to participate

Add New: QuestionText/MediaActionFrom Library

Add PageInsert from LibrarySkip/Disqualify LogicMerge Pages

365

Thank You Page: Thank you!

🚩 Responses are marked as complete when they reach this page (The Standard Survey will end on this page)



✍️ This page has display logic [View Conditions](#)

✍️ This question has display logic

[View Conditions](#)



Unfortunately, you could not complete the survey because you did not read or consent to participate in the study.

Should you change your mind, please go back and select "I agree", otherwise please close the page.

Thank you!

Send an Email

Sync with Salesforce

Redirect to a URL

Add New: Text/Media | Action

Add Page Insert from Library Skip/Disqualify Logic Merge Pages

Page 3: Selection Criterion - (1 of 2)

The following question help us determine if you meet our selection criteria for this study.



Which of the following best describes your dietary intake? ***This question is required.**

- ☐ I am primarily a vegetarian
- ☐ I am primarily a vegan



- ☐ I have mixed diet which includes white meat
- ☐ I have mixed diet which includes red meat
- ☐ I have mixed diet which includes red and white meat



Add New: Question | Text/Media | Action | From Library

Skip/disqualify Action

Page Logic



IF

The answer to Question Which of the following best describes your dietary intake? is one of the following answers I am primarily a vegetarian, I am primarily a vegan or I have mixed diet which includes white meat

THEN

Disqualify and display:

Sorry, you do not qualify to take this survey.

Add Page Insert from Library Skip/Disqualify Logic Merge Pages

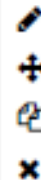
Page 4: Selection Criterion - (2 of 2)

The following question help us determine if you meet our selection criteria for this study.



Where do you usually buy your meat products? ***This question is required.**

- ☐ Fresh food markets / Butchers
- ☐ Delicatessens
- ☐ Online
- ☐ Supermarkets



Add New: Question | Text/Media | Action | From Library

Skip/disqualify Action

Page Logic




IF

The answer to Question Where do you usually buy your meat products? is one of the following answers Online

THEN

Disqualify and display:
Sorry, you do not qualify to take this survey.

 Add Page  Insert from Library  Skip/Disqualify Logic  Merge Pages

Page 5: Section A - (1 of 5)

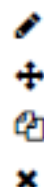
1. When you go into a store to buy groceries and/or fresh meat, how long does it usually take you to complete shopping and payment at the counter? ***This question is required.**

- ☐ Within 10 minutes
- ☐ More than 10 minutes but less than 30 minutes
- ☐ More than 30 minutes but less than 1 hour
- ☐ More than 1 hour but less than 2 hours
- ☐ More than 2 hours



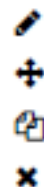
2. When you go into a store to buy groceries and/or fresh meat, how soon do you pick up fresh meat products and put them in your shopping basket/cart? ***This question is required.**

- ☐ In the beginning
- ☐ In the middle
- ☐ At the end



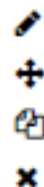
3. How long does it typically take you to transport your meat product from the place of purchase to your home? ***This question is required.**

- ☐ Less than 15 mins
- ☐ More than 15 mins but less than 30 mins
- ☐ More than 30 mins but less than an hour
- ☐ More than 1 hour but less than 2 hours
- ☐ More than 2 hours



4. Apart from the package that comes with meat products, which of the following best describes the way you usually package your fresh meat for the journey between the place of purchase to your home? ***This question is required.**

- ☐ I use an insulated bag or box
- ☐ I use a regular shopping bag
- ☐ I do not use any protective container



5. Assuming your fresh meat will not be cooked on the same day, which of the following describes how you will typically preserve your fresh meat? ***This question is required.**

- ☐ Chilling



- ☐ Freezing
- ☐ Dehydrating
- ☐ Salt preservation
- ☐ Canning/Vacuum packing



✎ This question has display logic

View Conditions ▼

Show if: Question "Assuming your fresh meat will not be cooked on the same day, which of the following describes how you will typically preserve your fresh meat?" #5 is one of the following answers ("Chilling")

6. Assuming your fresh meat will not be cooked immediately but on the same day, where is the fresh meat usually placed in the fridge? *This question is required.

- ☐ It is placed randomly
- ☐ It is placed in a separate compartment
- ☐ It is placed with other meat and seafood products
- ☐ It is placed with other cooked food products
- ☐ I have no regular storage system



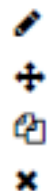
✎ This question has display logic

View Conditions ▼

Show if: Question "Assuming your fresh meat will not be cooked on the same day, which of the following describes how you will typically preserve your fresh meat?" #5 is one of the following answers ("Chilling")

7. How do you usually package your fresh meat for storage in the fridge? *This question is required.

- ☐ I use the original packaging of the meat
- ☐ I use a cling wrap
- ☐ I use a Ziploc bag
- ☐ I use an airtight container
- ☐ I use an open container
- ☐ I use a plastic bag



✎ This question has display logic

View Conditions ▼

Show if: Question "Assuming your fresh meat will not be cooked on the same day, which of the following describes how you will typically preserve your fresh meat?" #5 is one of the following answers ("Chilling")

8. How long would you typically store the fresh meat in your fridge? *This question is required.

- ☐ Less than 24 hours
- ☐ 1 to 2 days



- ☐ 2 to 4 days
- ☐ 4 to 6 days
- ☐ 1 week and above



Add New: Question | Text/Media | Action | From Library

Add Page Insert from Library Skip/Disqualify Logic Merge Pages

< 1 2 3 4 5 6 ... 18 >

Jump to page ▾ Show 5 pages at a time ▾

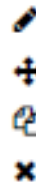
🔗 This question has display logic

View Conditions ▾

Show if: Question "Assuming your fresh meat will not be cooked on the same day, which of the following describes how you will typically preserve your fresh meat?" #5 is one of the following answers ("Freezing")

9. Which of the following describes how you would typically thaw an average steak-sized piece of frozen raw meat such as beef? *This question is required.

- ☐ I make use of the refrigerator
- ☐ I thaw at room temperature
- ☐ I thaw in cold water
- ☐ I thaw in hot water
- ☐ I use the microwave
- ☐ I cook from frozen



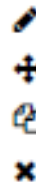
🔗 This question has display logic

View Conditions ▾

Show if: (Question "Assuming your fresh meat will not be cooked on the same day, which of the following describes how you will typically preserve your fresh meat?" #5 is one of the following answers ("Freezing") AND Question "Which of the following describes how you would typically thaw an average steak-sized piece of frozen raw meat such as beef?" #9 is one of the following answers ("I make use of the refrigerator"))

10. How long would you typically thaw an average steak sized piece of frozen raw beef in the refrigerator? *This question is required.

- ☐ Less than 6 hours
- ☐ More than 6 hours but less than 12 hours
- ☐ More than 12 hours but less than 1 day
- ☐ More than 1 day but less than 2 days
- ☐ More than 2 days



🔗 This question has display logic

View Conditions ▾

Show if: (Question "Assuming your fresh meat will not be cooked on the same day, which of the following describes how you will typically preserve your fresh meat?" #5 is one of the following answers ("Freezing") AND Question "Which of the following describes how you would typically thaw an average steak-sized piece of frozen raw meat such as beef?" #9 is one of the following answers ("I thaw at room temperature"))

11. How long would you typically thaw an average steak sized piece of frozen raw beef at room temperature? *This question is required.



- ☐ Less than 2 hours
- ☐ More than 2 hours but less than 4 hours
- ☐ More than 4 hours but less than 8 hours
- ☐ More than 8 hours but less than 10 hours
- ☐ More than 10 hours



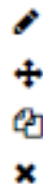
✎ This question has display logic

View Conditions ▾

Show if: (Question "Assuming your fresh meat will not be cooked on the same day, which of the following describes how you will typically preserve your fresh meat?" #5 is one of the following answers ("Freezing") AND Question "Which of the following describes how you would typically thaw an average steak-sized piece of frozen raw meat such as beef?" #9 is one of the following answers ("I thaw in cold water"))

12. How do you typically thaw an average steak sized piece of frozen raw beef in cold water? *This question is required.

- ☐ I place the meat, along with its original packaging, in water
- ☐ I remove the meat from its original packaging and place it in water
- ☐ I place the meat along with its original packaging in a leak-proof bag before placing it in water
- ☐ I remove the meat from its original packaging and place it in a leak-proof bag before placing it in water



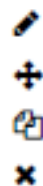
✎ This question has display logic

View Conditions ▾

Show if: (Question "Assuming your fresh meat will not be cooked on the same day, which of the following describes how you will typically preserve your fresh meat?" #5 is one of the following answers ("Freezing") AND Question "Which of the following describes how you would typically thaw an average steak-sized piece of frozen raw meat such as beef?" #9 is one of the following answers ("I thaw in cold water"))


13. How long would you typically thaw an average steak sized piece of frozen raw beef in cold water? *This question is required.

- ☐ More than 15 minutes but less than 30 minutes
- ☐ More than 30 minutes but less than 1 hour
- ☐ More than 1 hour but less than 2 hours
- ☐ More than 2 hours but less than 4 hours
- ☐ More than 4 hours



Add New: Question | Text/Media | Action | From Library

Page 7: Section A - (3 of 5)

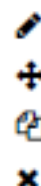
 This question has display logic


View Conditions ▼

Show if: Question "Assuming your fresh meat will not be cooked on the same day, which of the following describes how you will typically preserve your fresh meat?" #5 is one of the following answers ("Freezing")

14. After thawing your frozen raw meat, do you usually cook it immediately? *This question is required.

- ☐ Yes
- ☐ No



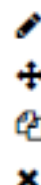
 This question has display logic


View Conditions ▼

Show if: Question "Assuming your fresh meat will not be cooked on the same day, which of the following describes how you will typically preserve your fresh meat?" #5 is one of the following answers ("Freezing")

15. After thawing your frozen raw meat, do you always cook it before putting back in the fridge?

- ☐ Yes
- ☐ No



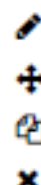
 This question has display logic

View Conditions ▼

Show if: (Question "Assuming your fresh meat will not be cooked on the same day, which of the following describes how you will typically preserve your fresh meat?" #5 is one of the following answers ("Freezing") AND Question "After thawing your frozen raw meat, do you usually cook it immediately?" #14 is one of the following answers ("No"))

16. After thawing your frozen raw meat, how long does it typically take you to start cooking it?

- ☐ Less than 1 hour
- ☐ More than 1 hour but less than 2 hours
- ☐ More than 2 hours but less than 4 hours
- ☐ More than 4 hours but less than 6 hours
- ☐ More than 6 hours



17. While cooking, how do you typically assess how well-cooked your meat is? *This question is required.

- ☐ I consider the colour of the meat as a safe indicator
- ☐ I make use of a thermometer

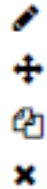


- ☐ I make use of a fork/tong to test the doneness of the meat
- ☐ I make use of my hands and/or fingertips
- ☐ I use personal estimation based on experience
- ☐ I taste it



18. How well-cooked do you prefer your meat? *This question is required.

- ☐ Rare
- ☐ Medium rare
- ☐ Medium
- ☐ Medium well
- ☐ Well done



This question has display logic

View Conditions ▼

Show if: (Question "While cooking, how do you typically assess how well-cooked your meat is?" #17 is one of the following answers ("I make use of a thermometer") AND Question "How well-cooked do you prefer your meat?" #18 is one of the following answers ("Rare"))

19. What temperature do you consider safe when cooking an average sized piece of rare meat? *This question is required.

- ☐ 53 oC
- ☐ 57 oC
- ☐ 60 oC
- ☐ 63 oC
- ☐ 67 oC



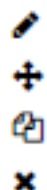
This question has display logic


View Conditions ▼

Show if: (Question "While cooking, how do you typically assess how well-cooked your meat is?" #17 is one of the following answers ("I make use of a thermometer") AND Question "How well-cooked do you prefer your meat?" #18 is one of the following answers ("Medium rare"))

20. What temperature do you consider safe when cooking an average sized piece of a medium rare cooked meat? *This question is required.

- ☐ 57 oC
- ☐ 60 oC
- ☐ 63 oC
- ☐ 67 oC
- ☐ 69 oC



 This question has display logic

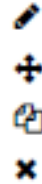
View Conditions ▼


Show if: (Question "While cooking, how do you typically assess how well-cooked your meat is?" #17 is one of the following answers ("I make use of a thermometer") AND Question "How well-cooked do you prefer your meat?" #18 is one of the following answers ("Medium"))

21. What temperature do you consider safe when cooking an average sized piece of medium cooked meat?

*This question is required.

- ☐ 63 oC
- ☐ 67 oC
- ☐ 71 oC
- ☐ 75 oC
- ☐ 77 oC



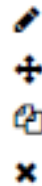
 This question has display logic


View Conditions ▼

Show if: (Question "While cooking, how do you typically assess how well-cooked your meat is?" #17 is one of the following answers ("I make use of a thermometer") AND Question "How well-cooked do you prefer your meat?" #18 is one of the following answers ("Medium well"))

22. What temperature do you consider safe when cooking an average sized piece of a medium well cooked meat? *This question is required.

- ☐ 67 oC
- ☐ 70 oC
- ☐ 73 oC
- ☐ 75 oC
- ☐ 77 oC



 This question has display logic

View Conditions ▼

Show if: (Question "While cooking, how do you typically assess how well-cooked your meat is?" #17 is one of the following answers ("I make use of a thermometer") AND Question "How well-cooked do you prefer your meat?" #18 is one of the following answers ("Well done"))

23. What temperature do you consider safe when cooking an average sized piece of a well done meat? *This question is required.

- ☐ 73 oC
- ☐ 75 oC
- ☐ 77 oC
- ☐ 82 oC
- ☐ 85 oC




Add New: Question | Text/Media | Action | From Library

 Add Page  Insert from Library  Skip/Disqualify Logic  Merge Pages

Page 8: Section A - (4 of 5)

On this page, you will be asked a question about how you cook a 3.5cm thick fillet steak. The following image gives you an idea about how thick a 3.5cm steak is.



 This question has display logic


View Conditions ▼

Show if: Question "How well-cooked do you prefer your meat?" #18 is one of the following answers ("Rare")

24. How long will you typically pan-fry a rare 3.5cm thick fillet beef steak in total? ***This question is required.**

- ☐ Less than 3 minutes
- ☐ More than 3 minutes but less than 4 minutes
- ☐ More than 4 minutes but less than 5 minutes
- ☐ More than 5 minutes but less than 6 minutes
- ☐ More than 6 minutes



 This question has display logic

View Conditions ▼

Show if: Question "How well-cooked do you prefer your meat?" #18 is one of the following answers ("Medium rare")

25. How long will you typically pan-fry a medium rare 3.5cm thick fillet beef steak in total? *This question is required.

- ☐ Less than 4 minutes
- ☐ More than 4 minutes but less than 5 minutes
- ☐ More than 5 minutes but less than 6 minutes
- ☐ More than 6 minutes but less than 7 minutes
- ☐ More than 7 minutes



This question has display logic

[View Conditions](#)

Show if: Question "How well-cooked do you prefer your meat?" #18 is one of the following answers ("Medium")

26. How long will you typically pan-fry a medium cooked 3.5cm thick fillet beef steak in total? *This question is required.

- ☐ Less than 6 minutes
- ☐ More than 6 minutes but less than 7 minutes
- ☐ More than 7 minutes but less than 8 minutes
- ☐ More than 8 minutes but less than 9 minutes
- ☐ More than 9 minutes



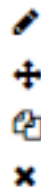
This question has display logic

[View Conditions](#)

Show if: Question "How well-cooked do you prefer your meat?" #18 is one of the following answers ("Medium well")

27. How long will you typically pan-fry a medium well 3.5cm thick fillet beef steak in total? *This question is required.

- ☐ Less than 10 minutes
- ☐ More than 10 minutes but less than 11 minutes
- ☐ More than 11 minutes but less than 12 minutes
- ☐ More than 12 minutes but less than 13 minutes
- ☐ More than 13 minutes



This question has display logic

[View Conditions](#)

Show if: Question "How well-cooked do you prefer your meat?" #18 is one of the following answers ("Well done")

28. How long will you typically pan-fry a well done 3.5cm thick fillet beef steak in total? *This question is required.

- ☐ Less than 10 minutes



- ☐ More than 10 minutes but less than 11 minutes
- ☐ More than 11 minutes but less than 12 minutes
- ☐ More than 12 minutes but less than 13 minutes
- ☐ More than 13 minutes



29. Do you usually have leftover cooked meat in your kitchen? ***This question is required.**

- ☐ Yes
- ☐ No



This question has display logic

View Conditions ▼

Show if: Question "Do you usually have leftover cooked meat in your kitchen?" #29 is one of the following answers ("Yes")

30. Which of the following describes how long you typically cool leftover cooked meat prior to storage? ***This question is required.**

- ☐ I cool it at room temperature for less than an hour
- ☐ I cool it at room temperature for more than 1 hour but less than 2 hours
- ☐ I cool it at room temperature for more than 2 hour but less than 4 hours
- ☐ I cool it at room temperature till I believe it is okay
- ☐ I cool it in the refrigerator



This question has display logic

View Conditions ▼

Show if: Question "Do you usually have leftover cooked meat in your kitchen?" #29 is one of the following answers ("Yes")

31. How do you usually store your leftover cooked meat?

- ☐ Chilling
- ☐ Leaving on the counter
- ☐ Room temperature
- ☐ Freezing



This question has display logic

View Conditions ▼

Show if: (Question "Do you usually have leftover cooked meat in your kitchen?" #29 is one of the following answers ("Yes") AND Question "How do you usually store your leftover cooked meat?" #31 is one of the following answers ("Chilling"))

32. When storing leftover cooked meat, which of the following items will you typically place next to the cooked meat in the fridge? ***This question is required.**



- ☐ Seafood products
- ☐ Raw meat products
- ☐ Fruits and vegetables
- ☐ Canned or tinned products
- ☐ None of the items above, I prefer to have it secluded
- ☐ None of the items above, some other food items
- ☐ Anything because I don't think it matters



This question has display logic

View Conditions ▾

Show if: (Question "Do you usually have leftover cooked meat in your kitchen?" #29 is one of the following answers ("Yes") AND Question "How do you usually store your leftover cooked meat?" #31 is one of the following answers ("Chilling"))

33. How do you usually package your leftover cooked meat for storage in the fridge? *This question is required.

- ☐ I use a cling wrap
- ☐ I use a Ziploc bag
- ☐ I use an airtight container
- ☐ I use an open container
- ☐ I use a regular container



This question has display logic

View Conditions ▾

Show if: (Question "Do you usually have leftover cooked meat in your kitchen?" #29 is one of the following answers ("Yes") AND Question "How do you usually store your leftover cooked meat?" #31 is one of the following answers ("Chilling"))

34. Which of the following describes how long you typically store leftover cooked meat in the refrigerator? *This question is required.

- ☐ Less than 24 hours
- ☐ More than 1 day but less than 2 days
- ☐ More than 2 days but less than 4 days
- ☐ More than 4 days but less than 6 days
- ☐ More than 6 days



This question has display logic

View Conditions ▾

Show if: Question "Do you usually have leftover cooked meat in your kitchen?" #29 is one of the following answers ("Yes")

35. Which of the following describes how much you usually reheat leftover meat? *This question is required.

- ☐ I reheat leftovers until it is warm



- ☐ I reheat leftovers until it is steaming hot
- ☐ I reheat leftover meat until I believe it is okay
- ☐ I do not reheat leftover meat



This question has display logic

View Conditions ▼

Show if: (Question "Do you usually have leftover cooked meat in your kitchen?" #29 is one of the following answers ("Yes") AND Question "Which of the following describes how much you usually reheat leftover meat?" #35 is one of the following answers ("I reheat leftovers until it is warm", "I reheat leftovers until it is steaming hot", "I reheat leftover meat until I believe it is okay"))

36. After reheating your leftover meat, how long does it typically take you to start eating the meat? *This question is required.

- ☐ Immediately
- ☐ Within an hour
- ☐ More than 1 hour but less than 2 hours
- ☐ More than 2 hours but less than 4 hours
- ☐ More than 4 hours



Add New: Question | Text/Media | Action | From Library

Add Page Insert from Library Skip/Disqualify Logic Merge Pages

Page 9: Section A - (5 of 5)

37. When preparing fresh meat, do you usually wear gloves? *This question is required.

- ☐ Yes
- ☐ No



38. When preparing fresh meat, do you usually cook other food products such as vegetables at the same time? *This question is required.

- ☐ Yes



- ☐ No



This question has display logic

View Conditions ▼

Show if: (Question "When preparing fresh meat, do you usually wear gloves?" #37 is one of the following answers ("Yes") AND Question "When preparing fresh meat, do you usually cook other food products such as vegetables at the same time?" #38 is one of the following answers ("Yes"))

39. Which of the following describes how you typically manage the simultaneous preparation of fresh meat and vegetables? *This question is required.

- ☐ I use a different set of gloves for the raw meat and a different set for the vegetables
- ☐ After cutting the raw meat, I rinse and re-use the same set of gloves for the vegetables
- ☐ After cutting the raw meat, I take off my gloves and cut the vegetables
- ☐ After cutting the raw meat, I immediately re-use the same set of gloves for the vegetables
- ☐ I usually cut the vegetables before I cut the raw meat
- ☐ I usually do not take note of how I manage my use of gloves when preparing raw meat and the vegetables



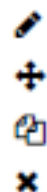
This question has display logic

View Conditions ▼

Show if: Question "When preparing fresh meat, do you usually wear gloves?" #37 is one of the following answers ("Yes")

40. Which of the following describes how often you typically change your gloves when preparing fresh meat? *This question is required.

- ☐ Every hour
- ☐ When they tear
- ☐ When changing tasks e.g. cleaning to cooking, preparation to serving
- ☐ When changing sub-tasks e.g. cutting raw meat to cutting vegetables
- ☐ After every meal preparation
- ☐ After completing all kitchen activities



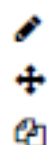
This question has display logic

View Conditions ▼

Show if: (Question "When preparing fresh meat, do you usually wear gloves?" #37 is one of the following answers ("No") AND Question "When preparing fresh meat, do you usually cook other food products such as vegetables at the same time?" #38 is one of the following answers ("Yes"))

41. Which of the following describes how you typically manage the simultaneous preparation of fresh meat and vegetables? *This question is required.

- ☐ I use a different knife and chopping board for the raw meat and different ones for the vegetables
- ☐ After cutting the raw meat, I rinse and re-use the same knife and chopping board for the vegetables



- ☐ After cutting the raw meat, I wash and re-use the same knife and chopping board for the vegetables
- ☐ After cutting the raw meat, I clean, sanitise, dry and re-use the same knife and chopping board for the vegetables
- ☐ After cutting the raw meat, I immediately re-use the same knife and chopping board for the vegetables
- ☐ I cut the vegetables before cutting the raw meat
- ☐ I usually do not take note of the utensils I use when preparing raw meat and the vegetables



This question has display logic

View Conditions ▼

Show if: Question "When preparing fresh meat, do you usually wear gloves?" #37 is one of the following answers ("No")

42. Which of the following describes when you usually wash your hands during fresh meat preparation? *This question is required.

- ☐ Before meal preparation
- ☐ Between meal preparation
- ☐ After meal preparation
- ☐ Before and after meal preparation
- ☐ Between and after meal preparation
- ☐ Before, between and after meal preparation
- ☐ I do not wash my hands



This question has display logic

View Conditions ▼

Show if: (Question "When preparing fresh meat, do you usually wear gloves?" #37 is one of the following answers ("No") AND Question "Which of the following describes when you usually wash your hands during fresh meat preparation?" #42 is one of the following answers ("Before meal preparation", "Between meal preparation", "After meal preparation", "Before and after meal preparation", "Between and after meal preparation", "Before, between and after meal preparation"))

43. Which of the following describes how you usually wash your hands when preparing fresh meat? *This question is required.

- ☐ I rinse my hands with water
- ☐ I briefly wash my hands with soap and hot water
- ☐ I wash my hands with soap and hot water for more than 10 seconds
- ☐ I wash my hands with soap and cold water
- ☐ I do not wash my hands



This question has display logic

View Conditions ▼

Show if: Question "When preparing fresh meat, do you usually wear gloves?" #37 is one of the following answers ("No")

44. Which of the following   hands when preparing fresh meat? *This question is required.

- ☐ I dry my hands on my clothes or apron
- ☐ I dry my hands with the same towel used in drying the dishes
- ☐ I dry my hands with a specific towel
- ☐ I dry my hands with paper towel
- ☐ I do not dry my hands while cooking



Add New: Question | Text/Media | Action | From Library

 Add Page  Insert from Library  Skip/Disqualify Logic  Merge Pages

Page 10: Section B - (1 of 6)

45. Before purchasing a food product, diverse types of information are usually considered. Please choose ONE MOST IMPORTANT and ONE LEAST IMPORTANT information which you typically consider before buying meat products.

Please note: You will be evaluating 3 sets of information types. Click Next to advance to the next set. *This question is required.

Least Important (Please choose one only)	Information considered before buying food	Most Important (Please choose one only)
<input type="radio"/>	Cooking instructions / Portion Information	<input type="radio"/>
<input type="radio"/>	Discounted products	<input type="radio"/>
<input type="radio"/>	Nutritional / health benefits (e.g. low fat, reduced salt, lowers cholesterol, organic)	<input type="radio"/>
<input type="radio"/>	Environmental impact (e.g. carbon footprint)	<input type="radio"/>

1 of 3 sets



Add New: Question | Text/Media | Action | From Library

46. Please choose **ONE MOST LIKELY** and **ONE LEAST LIKELY** *safety or nutritional label; environmental sustainability label; ethical or religious label* which you typically consider when buying meat products?

Please note: You will be evaluating 5 sets of attributes. Click Next to advance to the next set. *This question is required.

Least Likely to Consider (Please Choose One Only)

Labels you typically consider

Most Likely to Consider (Please Choose One Only)

Biodegradable Packaging



Livestock Welfare Certified System



Meat Standards Australia



Animal Welfare





National Carbon Offset
Standard



1 of 5 sets

Add New: Question | Text/Media | Action | From Library

Add Page Insert from Library Skip/Disqualify Logic Merge Pages

Page 12: Section B - (3 of 6)

47. Please choose **ONE MOST PREFERRED** and **ONE LEAST PREFERRED** information presentation format that is relevant to you when learning about safe food management.

Please note: You will be evaluating 2 sets of information format. Click Next to advance to the next set. *This question is required.

Least Preferred (Please Choose One Only)

☐☐☐☐

1 of 2 sets

Information Format

Integrated Information Format

Graphical or Picture-based Information

Documents or Text-based Information

Audio-based Information

Most Preferred (Please Choose One Only)

☐☐☐☐

Add New: Question | Text/Media | Action | From Library

Add Page Insert from Library Skip/Disqualify Logic Merge Pages

Page 13: Section B - (4 of 6)

48. Do you think a mobile safe food management application "app" will be useful to you as a consumer?

- ☐ Yes
- ☐ No
- ☐ Unsure



This question has display logic

View Conditions ▾

Show if: Question "Do you think a mobile safe food management application "app" will be useful to you as a consumer?" #48 is one of the following answers ("Yes")

49. Assume you are ordering a personalised mobile safe food management application "app". Please choose ONE RELEVANT and ONE IRRELEVANT guideline regarding the visual properties of the app.

Please note: You will be evaluating 2 sets of guidelines. Click Next to advance to the next set. *This question is required.

Irrelevant (Please Choose One Only)	Guideline	Relevant (Please Choose One Only)
<input type="radio"/>	Pie Charts can be used to illustrate information	<input type="radio"/>
<input type="radio"/>	Photographs should not be used, and the images should be stylized (e.g., cartoons).	<input type="radio"/>
<input type="radio"/>	Images such as Australian map or State-based maps can be used to illustrate information	<input type="radio"/>

1 of 2 sets



Add New: Question | Text/Media | Action | From Library

Add Page Insert from Library Skip/Disqualify Logic Merge Pages

Page 14: Section B - (5 of 6)

This question has display logic

View Conditions ▾

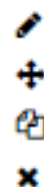
Show if: Question "Do you think a mobile safe food management application "app" will be useful to you as a consumer?" #48 is one of the following answers ("Yes")

50. Do you have other thoughts on the visual or other properties of a safe food management "app" that is specifically designed for you?

If yes, please type it in the box below. *This question is required.

- ☐ Yes
- ☐ No

Comments



Add New: Question | Text/Media | Action | From Library

Add Page Insert from Library Skip/Disqualify Logic Merge Pages

Page 15: Section B - (6 of 6)

51. Please choose ONE MOST LIKELY and ONE LEAST LIKELY communication channel which you would typically use when learning about safe management of meat and other food products?

Please note: You will be evaluating 3 sets of communication channels. Click Next to advance to the next set. *This question is required.

Least Likely (Please Choose One Only)

☐☐☐☐

Communication Channels

Read or take part in forums or chat groups online

Ask retailers

Use a search engine such as Google or read online articles

Use social networking sites such as Facebook, MySpace, Google+

Most Likely (Please Choose One Only)

☐☐☐☐

1 of 3 sets




Add New: Question | Text/Media | Action | From Library

Add Page Insert from Library Skip/Disqualify Logic Merge Pages

< 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 ... 18 >

Jump to page ▾ Show 5 pages at a time ▾

Page 14: Section B - (5 of 6)

 This question has display logic

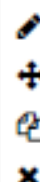
View Conditions ▾

50. Do you have other thoughts on the visual or other properties of a safe food management "app" that is specifically designed for you?


If yes, please type it in the box below. *This question is required.

- ☐ Yes
- ☐ No

Comments



Add New: Question | Text/Media | Action | From Library

 Add Page



Skip/Disqualify Logic



Merge Pages

Page 15: Section B - (6 of 6)

51. Please choose ONE MOST LIKELY and ONE LEAST LIKELY communication channel which you would typically use when learning about safe management of meat and other food products?

Please note: You will be evaluating 3 sets of communication channels. Click Next to advance to the next set. *This question is required.

Least Likely (Please Choose One Only)

Communication Channels

Most Likely (Please Choose One Only)

☐

Watch television

☐
☐

Read newspapers, brochures, posters or pamphlets

☐
☐

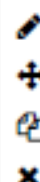
Listen to the radio

☐
☐


Watch videos online e.g. on YouTube

☐

1 of 3 sets



Add New: Question | Text/Media | Action | From Library

 Add Page



Insert from Library



Skip/Disqualify Logic



Merge Pages

Page 16: Section C - (1 of 1)

This is the final section.



Finally, a few questions to make sure that the people being surveyed are from a wide range of backgrounds. Studies of people's choices suggest that age, income, and other factors influence the choices people make.

52. Gender ***This question is required.**

- ☐ Male
- ☐ Female
- ☐ I prefer not to say



53. Age Group ***This question is required.**

- ☐ 18-29
- ☐ 30-49
- ☐ 50+



54. Location ***This question is required.**

- ☐ Australian Capital Territory
- ☐ New South Wales
- ☐ Northern Territory
- ☐ Queensland
- ☐ South Australia
- ☐ Tasmania
- ☐ Victoria
- ☐ Western Australia



55. Education ***This question is required.**

- ☐ 12th grade or less
- ☐ Graduated high school or equivalent
- ☐ Higher education







56. Household Income ***This question is required.**

- ☐ Less than \$25,000
- ☐ \$25,000 to \$49,999
- ☐ \$50,000 to \$74,999
- ☐ \$75,000 to \$99,999
- ☐ \$100,000 or more



Add New: Question | Text/Media | Action | From Library

 Add Page  Insert from Library  Skip/Disqualify Logic  Merge Pages


Page 17: Confirm survey completion

Thank you for taking the survey. Your kind assistance is highly appreciated.


Please click on the "submit" button below in order to save your responses.



Add New: Question | Text/Media | Action | From Library

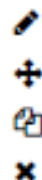
 Add Page  Insert from Library  Skip/Disqualify Logic

Thank You Page: Thank You!

 Responses are marked as complete when they reach this page (The Standard Survey will end on this page)



Thank you!



Send an Email

Sync with Salesforce

Redirect to a URL

Add New: Text/Media | Action

18 APPENDIX I – QUESTIONNAIRE FOR FOCUS GROUP PARTICIPANTS

Short Questionnaire

Thanks for participating in this focus group. To have a better understanding of the reasons for your responses, we will like you to please fill this questionnaire. Please be assured that your responses are completely confidential. You will be asked questions regarding the following; demography, smart phone usage and meat related questions.

This questionnaire will take approximately 5 minutes to complete.

1. Age Group

- ☐ 18 – 29 ☐ 30 – 49 ☐ 50+

2. Gender

- ☐ Male ☐ Female

3. Highest Level of education obtained

- ☐ Bachelor or higher ☐ Diploma / Advanced Diploma
☐ Certificate
☐ College / Year 12 ☐ High school / Year 10

4. Do you currently own/use a Smart Phone?

- ☐ Yes ☐ No

5. What is your Smartphone Model (for example: iPhone 6, Samsung Galaxy S6)?

To check your model, you can visit the following websites:

- Apple iOS: <http://whatismyiosversion.com/>
- Google Android: <http://whatismyandroidversion.com/>

NOTE: You need to go to these websites on your phone for it to be able to identify the model of the device.

6. How long have you been using smartphones?

- ☐ Less than 6 months ☐ More than 6 months but less than 1 year

☐ More than 1 year but less than 2 years ☐ More than 2 years but less than 4 years

☐ More than 4 years

7. How long have you owned your current smartphone?

☐ Less than 6 months ☐ More than 6 months but less than 1 year

☐ More than 1 year but less than 2 years ☐ More than 2 years but less than 4 years

☐ More than 4 years

8. How would you rate your smartphone use from 'light' to 'heavy'?

Light 1 2 3 4 5 Heavy

☐ ☐ ☐ ☐ ☐

9. How many hours per day do you spend using your smartphone on average?

☐ Less than 1 hour ☐ 1-2 hours ☐ 2-3 hours ☐ 3-4 hours ☐ 4+ hours

10. For what purposes do you use your smartphone the most? Please select all that apply.

☐ Calling people ☐ Games ☐ Weather ☐ Social Networking ☐ Music
☐ Productivity (calendars, etc.) ☐ News ☐ Sports ☐ Shopping
☐ Video / Movies ☐ Surfing the web Other:

11. What is your favourite smartphone application?

12. Do you have a profile on any of the Social Networking sites (e.g., Facebook, Twitter)?

☐ Yes ☐ No

13. Have you downloaded an App to your phone in the past week?

☐ Yes ☐ No

14. If so, how many Apps?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 or more

15. Which of the following best describes your dietary intake?

- ☐ I am primarily a vegetarian ☐ I am primarily a vegan
- ☐ I have mixed diet which includes white meat
- ☐ I have mixed diet which includes red meat
- ☐ I have mixed diet which includes red and white meat

16. Where do you usually buy your fresh meat products?

- ☐ Fresh food markets / Butchers ☐ Delicatessens
- ☐ Online ☐ Supermarkets

17. How often do you cook meat?

- ☐ At least once a week ☐ At least once a fortnight
- ☐ At least once a month ☐ Never

18. Are you willing to test the usability of the smartphone app that will be designed based on the outcome of this focus group?

- ☐ Yes ☐ No

19. If so, please provide your email address.

Thank you

19 APPENDIX J – TEXTUAL CONTENTS OF THE SMARTPHONE APP AND PAPER-BASED TOOL

Learning Material for Document Users

Food Safety in the Home

Instruction(s)

Please note that you are not allowed to use the learning material assigned to the other group throughout the 4 weeks experiment. However, after the 4 weeks study, you will be given access to the other group's learning material. A learning material is either an app or a document.

1. Sections

- Preparation
- Kitchen Hygiene
- Storage
- Thawing
- Transportation
- Shopping

2. Preparation Tips

<https://youtu.be/VWUr7Y-r6zo>

⊕ Important safe preparation tips

- ✓ Whole pieces of meat, such as steak, beef, pork and lamb, can be cooked to taste as long as the outside of the meat is fully cooked to kill external bacteria.
- ✓ Always cook chicken, rolled and stuffed meats, sausages and minced meat, such as hamburger patties and sausages, so that the juices run clear – there should be no hint of pink in the centre.
- ✓ If you are unsure as to whether these foods have been sufficiently cooked, check that in the thickest part the temperature reaches 75°C with a meat thermometer.

⊕ Special rules for barbecues

- ✓ Keep meat in the fridge until you are ready to barbecue it.
- ✓ Don't use the same plate for raw and cooked food.
- ✓ Keep raw and cooked meat covered to protect it from flies and other insects.

- ✓ Keep perishable products in the fridge until needed. Guests may like to nibble on these throughout the function, but bacteria will also have a feast! It is best to serve small amounts and replenish with fresh portions as required. Don't mix the fresh nibbles with ones that have been outside for some time.
- ✓ Don't use excess barbecue marinade over cooked meat before serving, if you want to make a sauce separate out some before adding the meat or heat it thoroughly before serving.
- ✓ Put leftover cooked meats and other perishables into the fridge immediately.

⊕ Guide to correct cooking temperature

Other sources of cooking times and temperature;

⊕ Reheating Leftovers

➤ Microwave cooking

Microwaves don't always cook food evenly, and microorganisms in cold spots may survive the cooking process.

- ✓ Carefully follow any instructions on cooking in the microwave that come with the product.
- ✓ Cover the food with a lid or microwave safe plastic-wrap, to trap steam.
- ✓ Stir food and turn large items over during cooking. Rotate the dish once or twice – even if you have a rotating turntable.
- ✓ Cut food into similarly sized pieces or arrange thicker pieces on the outside of the dish. Food continues to cook when the microwave is turned off.
- ✓ Always wait 3-5 minutes, or for the recommended standing time, before testing that cooking is complete

➤ Other reheating tips

- ✓ Always reheat to steaming hot (above 75°C).

- ✓ If food is not to be eaten straight away, it should be kept either below 4 °C or above 60 °C, to avoid growth of any harmful bacteria.

⊕ Specific cooking help

- ✓ Download the [REDACTED] app for Beef or Steak
- ✓ Download the [REDACTED] app for Lamb
- ✓ Download the [REDACTED] app for Veal or Goat

⊕ Meat Thermometers

A food thermometer helps you make sure all potentially harmful bacteria have been destroyed through proper cooking. A thermometer shows you the exact temperature inside the food so you can be sure it's cooked all the way through.

➤ Types of Thermometers

- ✓ The oven proof: This should be inserted into the meat before it is placed in the oven or cooked, with the dial facing forward so it can easily be read.
- ✓ Digital: The probe is placed in the meat and the wire run between the oven door seals to the digital read out which sits outside the oven.
- ✓ Instant read thermometers: Those that aren't oven proof but can be briefly inserted into the meat outside the oven for a few minutes to give a read out.
- ✓ Pop up thermometers: These are often purchased in packaged poultry or roasts and pop up when done – note these are not as accurate as other types of meat thermometer.
- ✓ Special microwave meat thermometers: Follow the instructions recommended by the manufacturer.

➤ How to use thermometers

- ✓ Poultry - insert the thermometer into the inner thigh area near the breast of the chicken or turkey, but not touching bone.
- ✓ Ground meat & poultry - the thermometer should also be placed in the thickest area of ground meat or poultry dishes like meatloaf.
- ✓ Beef, pork, lamb, veal, ham - roasts, steaks or chops – insert the thermometer into the centre of the thickest part, away from bone, fat and gristle.

- ✓ Casseroles and egg dishes - the thermometer should be inserted into the thickest portion.
- Other Tips on using a thermometer
 - ✓ Always carefully read the instructions before using a meat thermometer.
 - ✓ Remember to clean and sanitize the thermometer before you use it.
 - ✓ Poultry, sausages, hamburgers and rolled roast meat should reach an internal temperature of 75°C to ensure all food poisoning bacteria are killed.

2. Kitchen Hygiene

⊕ Cross Contamination

Cross contamination is preventable and encompasses good cleaning practices, good personal hygiene practices and some organisation to keep raw foods and contaminated utensils away from cooked and ready-to eat foods.

- How does cross contamination occur?
 - ✓ A dirty knife will deposit bacteria on freshly cooked meat.
 - ✓ Dirty hands will deposit bacteria on the next sandwich you make.
 - ✓ A dirty chopping board which has just had raw chicken on it will transfer those bacteria to your lettuce if you choose to use it without washing and sanitizing first.
 - ✓ The raw meat in the refrigerator is dripping juices (and bacteria) on to the food stored below.
- Avoiding cross-contamination
 - ✓ Keep dirty preparation activities well away from clean or cooked food.
 - ✓ Do not share utensils, plates and chopping boards between dirty operations and clean cooked food.
 - ✓ Never handle cooked and uncooked meats together.

- ✓ Do not cut up raw and cooked foods with the same utensils or use the same boards without thoroughly washing the board and the utensils, and, of course, your hands!
- ✓ In between handling raw and cooked foods, wash utensils such as tongs, knives and chopping boards with hot soapy water.
- ✓ Make sure that utensils and equipment are always clean.
- ✓ Wash hands thoroughly before preparation, after going to the toilet, and after handling pets and raw food.
- ✓ Avoid preparing food if you have symptoms such as diarrhea or vomiting.
- ✓ Avoid excessive handling of food because bacteria are always on our bodies.

⊕ Correct Hand Cleaning Technique

- ✓ A 10 second splash under the tap is not washing your hands.
- ✓ Use soap and warm water, rubbing for at least 30 seconds.
- ✓ Dry hands thoroughly on a paper towel or a clean towel.

⊕ Ensuring Clean Utensils

- ✓ Wash dishes as soon as possible when you have finished eating. If you have left them to soak in water, ensure they are well washed afterwards. Do not leave dirty dishes for more than a few hours.
- ✓ After washing, allow dishes to air dry.
- ✓ Utensils and chopping boards should be washed at the end of each meal in the same way as dishes.
- ✓ Disinfect chopping boards used for raw food at least once a week in a solution of weak bleach made from a teaspoon of bleach in a litre of water.
- ✓ If a tea towel is used, change it for a clean one when it becomes soiled or wet.
- ✓ Dish clothes and sponges should be kept clean and should be changed regularly.

- ✓ Clean dishcloths regularly in a solution of bleach or by putting them in the dishwasher with a load.
- ✓ Disposable paper towels are an alternative to dishcloths and sponges.
- ✓ Never use the same dishcloths and sponges you use for food contact surfaces for cleaning floors or other areas around the house.

⊕ Other Tips

- ✓ Clean all work surfaces and utensils well. Unclean surfaces can harbour harmful microbes. Drying surfaces well can contribute to the death of many bacteria.
- ✓ Keep clothes clean and dry.
- ✓ Chopping boards should be replaced when its surface becomes scratched because bacteria can hide in the scratches.

3. Storage Tips

Food storage is by far one of the most common forms of food abuse which contributes to foodborne illness. It is always the number one contributing factor in surveys of causes of food poisoning.

Bacteria need TIME and TEMPERATURE in order to be able to grow in foods. We are in control of both and we must not give either to the bacteria.

⊕ Refrigeration

➤ Raw Meat

The term 'meat' includes beef, lamb, pork, etc.

- Wrapped fresh meat
 - ✓ Can be kept safely for up to three days
 - ✓ Stored at 0° to 3° C
 - ✓ Meat becomes slimy after about three days.
 - ✓ If you notice an off odour, throw the food out.
- Unwrapped fresh meat
 - ✓ Can be kept safely for up to five days
 - ✓ Stored at 0° to 3° C
 - ✓ Store in an adequately ventilated container or loosen the wrapping around the meat so air can circulate.

- ✓ To ensure all surfaces are exposed to drying, place the meat on a clean stainless steel, chrome plated or plastic rack.
- ✓ Do not sit the meat on a plate or other solid surface, or pack it too closely.
- ✓ Unwrapped cured meat may last up to three weeks at 0° to 3° C.
- Minced meat, liver, kidneys, poultry and seafood
 - ✓ Requires careful storage because they usually carry large numbers of spoilage microorganisms.
 - ✓ Store in the coldest part of the refrigeration section as close as possible to 0° C.
 - ✓ The longest recommended storage time is three days.
- Chilled Chicken
 - ✓ Can be kept safely for up to three days
 - ✓ Stored at 0° to 3° C
 - ✓ Before storing ;
 - Take off the plastic wrapping,
 - Wash the chicken thoroughly,
 - Dry it with a paper towel then store as above.
- Meat designated as “Pet Food”
 - ✓ Should not come into direct contact with meat for human consumption.
 - ✓ It should be well wrapped
 - ✓ Store in the coldest part of the refrigerator.
- Expected shelf Life of Fresh Meat

This is the storage life of some chilled meat stored in the coldest part of a refrigerator (between 0°C and 3°C). Please see the refrigeration tips to ensure your best results.

Food	Expected shelf life in the home
Seafood	3 days
Crustaceans and molluscs	2 days
Meat	3-5 days
Minced meat and offal	2-3 days

Cured meat	2-3 weeks
Poultry	3 days

➤ Delicatessen Meat

Most delicatessen meats such as ham, corned beef, polish salami, and other luncheon meats must be stored in the fridge. They should be treated like fresh meat but they should not come into contact with fresh meat. Pâtés also fall into this group.

✚ General Storage Information

- ✓ Some of the fermented salamis, bacon and whole hams will keep for 2-3 weeks
- ✓ Sliced luncheon meats which will keep only 4-5 days after purchase.

✚ Tips on specific delicatessen items

- ❖ Unpackaged pre-sliced luncheon meats. When purchasing,
 - ✓ Examine the products on display carefully.
 - ✓ If there is any slime or excessive moisture, ask for slices to be freshly cut from the knob.
 - ✓ Buy only small quantities.
- ❖ Pre-packaged delicatessen items
 - ✓ Can be stored until the 'best before' date.
 - ✓ They are often vacuum packaged and have a longer shelf life.
 - ✓ But do buy carefully - avoiding damaged or blown packages.
 - ✓ A slight sour smell may be noticeable as the product starts to lose quality.
- ❖ Other delicatessen items
 - ✓ There are now a series of fermented salami knobs sold which are wrapped in plastic over the casing.
 - ✓ Make sure you read the storage instructions carefully.
 - ✓ While the unwrapped type could be stored outside the refrigerator, these wrapped

versions usually require refrigeration after the casing has been broken.

➤ Cooked Meat

❖ When to refrigerate?

- ✓ Meat, poultry and seafoods must be refrigerated as soon as possible after cooking.
- ✓ Do not leave them on the bench top to cool before placing them in the refrigerator.
- ✓ This is especially important with casserole-type dishes where food poisoning bacteria can actually survive the cooking process.
- ✓ Modern refrigerators can cope with small amounts of hot foods being placed directly into them.
- ✓ To avoid excessive condensation in the refrigerator, a brief cooling period (not more than one hour) prior to refrigeration is preferred.
- ✓ You may wish to use a timer to remind you when the time is up.

❖ How to refrigerate?

- ✓ To avoid condensation, do not cover hot meat pieces before refrigerating.
- ✓ Place them uncovered in the refrigerator until they are cool, then cover the container or wrap the meat tightly with cling wrap.
- ✓ Store cooked products above any raw meat, poultry or seafoods to avoid cross contamination from raw meat liquid or drip where this could occur.
- ✓ However, if the top shelves of your refrigerator are the coldest, the more perishable fresh meats should be stored there. Special care should then be taken to cover other dishes to prevent contamination.
- ✓ Large amounts of food should always be divided into smaller containers before cooling. It can take many hours for the centre of a large container to cool to a

temperature which will stop the growth of food poisoning bacteria.

❖ When to freeze?

- ✓ If you do not expect to eat the food within three or four days, it is best frozen immediately.

➤ Refrigeration Tips

❖ Appropriate refrigerator location

- ✓ Locate your refrigerator in an area with adequate air space to allow it to operate effectively.
- ✓ Read your instruction booklet. It will outline the clearances required.
- ✓ Avoid locating the refrigerator in very hot places such as next to an oven, or clothes dryer.

❖ Temperature Control

- ✓ Use a refrigerator thermometer
- ✓ Temperature should be below 4°C
- ✓ Keep the door of the refrigerator open for the shortest possible time.

❖ Ensuring Operating Efficiency

- ✓ Defrost the refrigerator regularly.
- ✓ Ice build-up reduces the operation efficiency. This does not apply to automatic defrost models.
- ✓ Door seals should also be checked regularly.

❖ Tips on Food Storage

- ✓ Store food you want to keep for a long time, or items like seafood which are quite susceptible to spoilage, in the coldest part of the refrigerator.
- ✓ Cover all cooked foods and when practical store them on a shelf above uncooked foods. This minimises the risk of food poisoning organisms being transferred from uncooked to cooked food through drip.
- ✓ Dispose of any spoiled food. Putting it in a colder part of the refrigerator will not stop it deteriorating further.

❖ Avoiding Odour Transmission

- ✓ Foods with strong odours, such as seafoods and some cheeses, should be wrapped, and you should avoid storing them for long periods near food such as milk and cream which are susceptible to tainting.
- ✓ Some flexible films are effective barriers to the transmission of odours but they are not readily available to consumers. The common cling wrap polyethylene and PVC films are not very effective barriers but they are useful in the short term and stop spillages.
- ✓ Closed glass or plastic containers are preferable.

⊕ Freezing

➤ Frozen Storage Life

The Bacteria and viruses do not grow at freezer temperatures. Frozen storage cannot contribute to food poisoning. However, frozen storage can result in a deterioration of some food qualities if items are stored for excessively long periods. The following guide can be used for frozen storage:

Approximate Storage Life	Products
1 month	Offal
1-2 months	Bacon Sausages
2-3 months	Beef casserole Lamb casserole Lamb chops Lamb roast Mince
3 months	Chicken portions Oily Fish (e.g. mackerel)
3-4 months	Beef steaks Pork chops
4 months	Lean Fish
4-6 months	Beef roasts Whole chicken Pork roasts

➤ Tips for Freezing Food Safely

- ✓ The temperature in the freezer should be around minus 15°C to minus 18°C.
- ✓ Avoid freezing large amounts at a time.
- ✓ Split it into smaller quantities in separate containers.
- ✓ When freezing food you've just bought, place it in freezer bags to maintain quality. You don't need to unwrap pre-packaged raw meat on trays, just put it in a freezer bag. Tie the bag after squeezing out as much air as possible, label and date.
- ✓ If you are freezing cooked food or leftovers, the most important thing is to cool it quickly. Cool food on the bench only until it stops steaming. Then place the hot food directly into the container, cover with a lid and put it in the freezer.

⊕ Safe and Unsafe Temperatures

- ✓ Between 4 ° and 60 °C is the temperature danger zone because this is the temperature range in which food poisoning bacteria may grow.
- ✓ Keep the time food spends in the temperature danger zone of rapid microbial growth as short as possible.
- ✓ If food is to be served hot after cooking it should be kept above 60 °C.
- ✓ If the food is not to be eaten immediately after cooking, it should be cooled in the refrigerator to below 4 °C.
- ✓ Reheating should ensure that the centre of the food reaches 75 °C.
- ✓ The same precaution should be taken with fried and barbecued meats, particularly chicken bought from take-away food shops. If this type of food is not to be eaten straight away, it should be kept either below 4 °C or above 60 °C, to avoid growth of any harmful bacteria.

5. Thawing Tips

➤ Thawing in the refrigerator

- ✓ This should be done at a temperature below 4 °C.

- ✓ At least 24 to 48 hours in the refrigerator is usually required to thaw reasonably sized portions of foods such as whole chickens or rolled roasts.
- ✓ Special care is necessary when thawing and cooking turkeys or large pieces of meat—more than 3 kg.
- Thawing under cold running water
 - ✓ Thaw under cool running water without unwrapping the meat.
- Thawing in a microwave
 - ✓ Speed up the defrosting process by separating defrosted portions from the still frozen sections of food.
 - ✓ Do not unwrap the meat
- Cooking from frozen state
 - ✓ Smaller cuts of meat such as steaks and chops can be fried or grilled direct from the frozen state.
 - ✓ If you have to cook the meat before it has completely thawed, allow extra cooking time and ensure (by using a good meat thermometer) that the temperature in the middle of the joint has reached 71 °C.
- Important tips
 - ✓ It is important to thaw cooked or ready-to-eat food in the fridge unless the manufacturer directs otherwise.
 - ✓ Do not thaw on the bench-top.
 - ✓ Follow thawing instructions on packaged frozen food.
 - ✓ Defrost rolled and stuffed meat completely before cooking or else they may not cook right through.
 - ✓ Thawed food should not be refrozen. However, it can be stored safely in the chilling section of the refrigerator for up to 48 hours if it has been thawed properly under controlled conditions in the refrigerator.
 - ✓ It is bad practice to thaw meat, poultry or fish out of the refrigerator. If this has been done, it should never be put back into the refrigerator for use

later. If it cannot be cooked immediately, it should be thrown away.

6. Transportation Tips

- ✓ Ensure chilled and frozen foods are in an insulated cooler for the trip home.
- ✓ Always go directly home.
- ✓ Don't leave your shopping in a hot car.

7. Shopping Tips

- a. Pre-Shopping
 - ✓ Have an insulated container
 - ✓ Prepare your shopping list
 - ✓ Carefully select your meat retailer
- b. Shopping
 - Trolley Tips
 - ✓ Choose a clean trolley
 - ✓ Never put fresh fruit and vegetable directly into the trolley
 - ✓ Separate raw meat from ready to eat foods
 - Temperature Control
 - ✓ Select fresh meat products last
 - ✓ Carefully select meat. For example: "keep chilled products" must be in chilled storage, otherwise do not buy it.
 - Other tips
 - ✓ Examine products to detect defects.
 - ✓ Examine use-by and best-before dates
- c. Post-Shopping
 - ✓ Encourage the check-out operator to pack chilled and frozen items together by placing these items together on the conveyor belt.

References

1. Food Safety Information Council – Shopping and Storage Food Safety
<http://www.foodsafety.asn.au/resources/shopping-and-storage-food-safety/>

2. CSIRO – Refrigerated storage of perishable foods
<http://www.csiro.au/en/Research/Health/Food-safety/Refrigerating-foods>
3. CSIRO – Handling Food in the Home
<http://www.csiro.au/en/Research/Health/Food-safety/Food-handling>
4. Food Safety Information Council – Fridge and Freezer food safety
<http://www.foodsafety.asn.au/resources/fridge-and-freezer-food-safety/>
5. MLA – Food Safety Tips and Practices
<http://off-farm.mla.com.au/Food-safety/Food-safety-for-consumers/Food-safety-tips-and-practice>
6. MLA – Food Safety in the home brochure
<http://off-farm.mla.com.au/Food-safety/Food-safety-for-consumers>
7. Food Safety Information Council - Red Meat – Beef, Lamb, Pork, Venison And Kangaroo
<http://www.foodsafety.asn.au/resources/red-meat-beef-lamb-pork-venison-and-kangaroo/>
8. Food Safety Information Council – Meat Thermometers – How To Cook Meat And Poultry Safely
<http://www.foodsafety.asn.au/resources/meat-thermometers-how-to-cook-meat-and-poultry-safely/>
9. Food Safety Information Council – Minced Meat, Sausages, Hamburgers And Rolled Roast – Can These Be Served Rare?
<http://www.foodsafety.asn.au/faqs/minced-meat-sausages-hamburgers-and-rolled-roast-can-these-be-served-rare/>
10. Food Safety Information Council – Cross Contamination
<http://www.foodsafety.asn.au/resources/kitchen-food-safety/>
11. Food Safety Information Council – Videos
<http://www.foodsafety.asn.au/resources/videos/>
12. NSW Food Authority – Cooking Temperatures
<http://www.foodauthority.nsw.gov.au/consumers/keeping-food-safe/cooking-correctly#.VjalqrerK7o>
http://www.foodauthority.nsw.gov.au/Documents/consumer_pdf/safe_food_temperatures_poster.pdf

20 APPENDIX K – FULL FINDINGS OF HEURISTIC EVALUATION

The heuristic evaluation of the 3 existing apps is shown in the table below.

	Heuristic	Description	Text-based only	Text & Pictures	Integrated
Screens	Home Screen	Have a simple and engaging home screen	2	✓	3
	Registration	Make registration and logging in as simple and obvious as possible	N/A	N/A	N/A
Content	Hierarchy	Put the most important information first	✓	✓	1
	Promotion	Tell users what to do and how to do it	1	✓	✓
	Positive Tone	Stay positive and realistic. Include the benefits of taking action	3	3	✓
	Specific	Provide specific action steps	✓	✓	✓
	Colloquial	Write in plain language	✓	✓	✓
	Accurate	Check content for accuracy	✓	✓	✓
	Spacious	Display content clearly on the page	3	✓	✓
	Personal	Include a limited	3	2	✓

		amount of interactive content that users can tailor			
	Headings	Use meaningful headings	✓	1	✓
Display	Consistency	Ensure styles are consistent	✓	✓	✓
	Font	Ensure the font is easy to read	2	✓	✓
	Spacious	Use white space and avoid clutter	✓	1	✓
	Location of Content	Keep content in the centre of the screen and above the fold.	1	✓	✓
	Images	Use images that facilitate learning	N/A	1	✓
	Contrast	Use bold colours with contrast and avoid dark or busy backgrounds	1	1	✓
	Accessibility	Make the system accessible to people with disabilities	3	3	3
Navigation	Topics	Put topics in multiple categories	✓	1	1
	Orientation	Enable easy access to home and menu	✓	2	1

		screens			
	Back Button	Make sure the “Back” button works	✓	✓	1
	Linear Navigation	Use linear information paths (e.g., numbered screens)	1	✓	1
	Buttons	Simplify screen-based controls and enlarge buttons	1	✓	✓
	Links	Label links clearly and use them effectively	3	1	✓
	Search	Include simple search and browse options.	3	✓	3
Interactivity	Engage	Invite users to share content and provide feedback about their experiences	3	3	3
	Print	Include printer-friendly tools and resources	3	3	3
	Multimedia	Incorporate audio and visual features	N/A	1	✓
	New media	Explore new media such as Twitter or text messaging	3	3	3

21 APPENDIX L - SCENARIO BASED FOCUS GROUP QUESTIONS (QUANTITATIVE)

Usability Evaluation


Scenario-based Focus Group Session – Part 1

Group A

Please read the following scenarios. You will be asked to complete a few tasks using some smartphone apps. Please follow the order of the tasks as instructed here. Your answers will be recorded in the answer sheet provided.

Scenario 1

You are inviting a few friends for dinner, and your recipe includes beef steaks. You want to cook a rare 4cm (centimetres) thick rump steak to perfection. The steak weighs 500g (about 1 pound). Use the following app to find some information about how to cook it. Please note that either $^{\circ}\text{C}$ or $^{\circ}\text{F}$ is acceptable.

Download the “” app and browse through it in order to find the appropriate information you need so as to cook a perfect steak.


After downloading the app, please record the time you start and the time you stop using the app to find the required information – **Start time & End time**. *Please be careful to ensure you only record the time you use in browsing the app **NOT** the time you use in writing your answers.*

In your answer sheet, please provide answers to the following;

1. The start time
2. Did you already have the aforementioned app on your phone?
3. How long will it take you to cook it?
4. What method of cooking will you use? (E.g. Pan Fry, Barbecue, Roast etc.)
5. What cooking temperature is most appropriate? ($^{\circ}\text{F}$ or $^{\circ}\text{C}$)
6. Would you use the app again? Why?
7. The end time

Scenario 2

You are inviting a few friends for lunch, and your recipe includes lamb steaks. You want to cook a medium 2.5cm (centimetres) thick lamb fillet or tenderloin to perfection. Use the following app to find some information about how to cook it.

Download the “” app and browse through it in order to find the appropriate information you need so as to cook a perfect steak.


After downloading the app, please record the time you start and the time you stop using the app to find the required information – **Start time & End time**. *Please be careful to ensure you only record the time you use in browsing the app **NOT** the time you use in writing your answers.*

In your answer sheet, please provide answers to the following;

1. The start time
2. Did you already have the aforementioned app on your phone?
3. How long will it take you to cook it?
4. What method of cooking will you use? (E.g. Pan Fry, Barbecue, Roast etc.)
5. What cooking temperature is most appropriate? (⁰F or ⁰C)
6. Would you use the app again? Why?
7. The end time

Scenario 3

You are inviting a few friends for barbecue (BBQ), and your recipe includes beef steaks. You want to cook a medium rare 3cm (centimetres) thick sirloin steak to perfection. Use the following app to find some information about how to cook it.

Download the “” app and browse through it in order to find the appropriate information you need so as to cook a perfect steak.

After downloading the app, please record the time you start and the time you stop using the app to find the required information – **Start time & End time**. *Please be careful to*

*ensure you only record the time you use in browsing the app **NOT** the time you use in writing your answers.*

In your answer sheet, please provide answers to the following;

1. The start time
2. Did you already have the aforementioned app on your phone?
3. How long will it take you to cook it?
4. What method of cooking will you use? (E.g. Pan Fry, Barbecue, Roast etc.)
5. What cooking temperature is most appropriate? (⁰F or ⁰C)
6. Would you use the app again? Why?
7. The end time

22 APPENDIX M – ANSWER SHEET FOR THE QUANTITATIVE INFORMATION TASKS

Answer Sheet

Group Name:

Scenario 1 – XXXXXXXXXX **App**

S/N	Question	Answer
1	Start time	
2	Did you already have the aforementioned app on your phone? (Yes or No)	
3	Cooking time (how long to cook?)	
4	Cooking method <i>e.g. Pan Fry, Barbecue, Roast etc.</i>	
5	Temperature (⁰ F or ⁰ C)	
6	Would you use the app again? Why?	
7	End time	

Scenario 2 – XXXXXXXXXX **App**

S/N	Question	Answer
1	Start time	
2	Did you already have the aforementioned app on your phone? (Yes or No)	
3	Cooking time (how long to cook?)	
4	Cooking method <i>e.g. Pan Fry, Barbecue, Roast etc.</i>	

5	Temperature (⁰ F or ⁰ C)	
6	Would you use the app again? Why?	
7	End time	

Scenario 3 – XXXXXXXXXX App

S/N	Question	Answer
1	Start time	
2	Did you already have the aforementioned app on your phone? (Yes or No)	
3	Cooking time (how long to cook?)	
4	Cooking method <i>e.g. Pan Fry, Barbecue, Roast etc.</i>	
5	Temperature (⁰ F or ⁰ C)	
6	Would you use the app again? Why?	
7	End time	

23 APPENDIX N – SCENARIO BASED FOCUS GROUP QUESTIONS (QUALITATIVE)

Usability Evaluation

Scenario-based Focus Group Session – Part 2

Group A

Following on from Part 1, please answer the question associated with each scenario in as much detail as you can.

Scenario 1 - (Reminder)

You are inviting a few friends for dinner, and your recipe includes beef steaks. You want to cook a rare 4cm (centimetres) thick rump steak to perfection. The steak weighs 500g (about 1 pound). Please note that either °C or °F is acceptable.

1. Assuming you will use a thermometer while cooking; describe how you would ensure the rare 4cm thick rump steak is safely cooked without losing its taste?

Scenario 2 - (Reminder)

You are inviting a few friends for lunch, and your recipe includes lamb steaks. You want to cook a medium 2.5cm (centimetres) thick lamb fillet or tenderloin to perfection.

2. Describe how you would cook a perfect medium 2.5cm thick lamb fillet/tenderloin?

Scenario 3 - (Reminder)

You are inviting a few friends for barbecue (BBQ), and your recipe includes beef steaks. You want to cook a medium rare 3cm (centimetres) thick sirloin steak to perfection.

3. Remember the method of cooking here is BBQ; describe the actions you would take before and during the cooking process of the medium rare 3cm thick sirloin steak to ensure best results.

**24 APPENDIX O – ANSWER SHEET FOR QUALITATIVE
INFORMATION TASKS**

Answer Sheet

Group Name:

Scenario 1 – XXXXXXXXXX **App**

S/N	Question	Answer
1	Assuming you will use a thermometer while cooking; describe how you would ensure the rare 4cm thick rump steak is safely cooked without losing its taste?	

Scenario 2 – [REDACTED] App

S/N	Question	Answer
2	Describe how you would cook a perfect medium 2.5cm thick lamb fillet/tenderloin?	

Scenario 3 – [REDACTED] App

S/N	Question	Answer
3	Remember the method of cooking here is BBQ; describe the actions you would take <u>before</u> and <u>during</u> the cooking process of the medium rare 3cm thick sirloin steak to ensure best results.	

25 APPENDIX P – EXPERIMENT EXHIBITS FOR EACH TABLE (WEEK 4)

Table A



Table B



Table C



Table D



Exhibit 1 – Kitchen Hygiene (Cross Contamination)

TABLE A

Materials

- Knife
- Chopping Board
- Bowl or plate (3)

- Raw Beef
- Snow peas
- Tomatoes
- Onions

Context (Do not place this information on the table)

- Vegetables placed in a container and it is placed on a benchtop
- Raw beef placed on a chopping board and placed on the benchtop, not too far from the vegetables
- Knife has cut beef into 2 pieces and knife is placed in between the two pieces.
- 2 extra bowls are placed on the table

Exhibit 2 – Preparation

Table B

Materials

- A well done whole chicken roast
- **A meat thermometer**
- **A plate**
- Place the chicken on a plate and put the thermometer beside it.

Context (Place this information on the table)

- This premium quality chicken does not contain any antibiotic
- The chicken can be traced to the Tasmanian farmer
- The chicken was fed with non-genetically modified feed
- The chicken was cooked to the highest safety standards
- After cooking the chicken, it was immediately placed here 130 minutes ago
- The chicken is well done as it was roasted at 220°C for 1 hour and 10 minutes

Exhibit 3 – Kitchen Hygiene

Table C

Materials

- **Chopping board**
- **Knife**
- **1 bowl**
- **1 kitchen towel**

- Raw pork (big chunk) / Diced raw pork

Context (Do not place this information on the table)

- Raw pork on a chopping board and knife
- Diced raw pork in a different container
- Kitchen towel soiled with raw pork juice

Exhibit 4 – Storage

Table D

Materials

- **Fridge**
- **Fridge Thermometer**
- Raw Salmon Fish
- **Plastic airtight container (2)**
- Ready to eat Salad

Context (Do not place this information on the table)

- Fish in a sealed plastic container labelled “**Uncooked Premium Tasmanian Salmon**”
- Salad in a covered container labelled “**Garden Salad**”
- Cooked food placed above Fish

26 APPENDIX Q – INFORMATION SHEET FOR EXPERIMENT PARTICIPANTS

University of Tasmania School of Engineering and ICT

Participant Information Sheet (version 02) (14/01/2015)

An Investigation into Food Safety Knowledge Optimization in Consumer Confidence Improvement

[This information sheet is for all participants.](#)

1. Invitation

This research will investigate the role of managing information and knowledge dynamics in the improvement of consumer confidence, specifically amongst firms with supply chain challenges concerning food quality and food safety.

This study is being conducted in partial fulfillment of a PhD Information Systems degree for Adeola Bamgboje in the School of Engineering and ICT. The research is being supervised by Dr Leonie Ellis and A/Prof Paul Turner.

2. What is the purpose of this study?

This research aims to explore the fundamental challenge of how the food industry can more effectively optimize knowledge to dynamically respond to the diversity of changing consumer attitudes and behaviours. To do this, this research needs insight into how this app helps you understand safe food handling in the home.

3. Why have I been invited to participate?

You are being invited to participate in this research because you have responded to the advert of this study and you have agreed to be part of this research. This research is conducting a 5-week field experiment to investigate the impact of a user-led design of a food safety mobile phone application to know if the developed app helps you understand how food should be safely handled in your home.

Your involvement to this study is voluntary and we respect your right to decline to participate. There are no consequences if you decide not to participate and that this will not affect how you will be perceived by the researchers.

4. What will I be asked to do?

As a research participant, you will be asked to provide a maximum of four hours of your time throughout the 5 week experiment. The four hours will be divided into 2 hours, 30 minutes, 40 minutes and 45 minutes respectively for each of sessions. You will be asked to fill closed ended questionnaires in the first two sessions and you will be asked to answer open ended questions in the last two sessions. Only the first session will be audio recorded. However, your name or any other identifiers will not be recorded or transcribed as part of the data collection. All information will be treated in a confidential manner. All of the research data will be kept at the University of Tasmania in a locked cabinet in the office of the Primary Researcher. All data will be destroyed under appropriate supervision after the mandatory 5-year period.

5. Are there any possible benefits from participation in this study?

It is anticipated that your participation will greatly benefit you as a premium food consumer, as well as the Australian food industry as a whole. This research may provide an improved way of providing food safety information to consumers.

6. Are there any possible risks from participation in this study?

There are no anticipated risks that may arise from participating in this study.

7. What if I change my mind during or after the study?

Research participants may choose to withdraw at any time before or during the sessions without providing an explanation. It is important that you understand that your involvement in this study is voluntary. While we would be pleased to have you participate, we respect your right to decline. There will be no consequences to you if you decide not to participate. If you decide to discontinue participation at any time, you may do so without providing an explanation.

8. What will happen to the information when this study is over?

The data will be kept securely within the School of Engineering and ICT in a digital form. Only the researchers will have access to the raw data. The data will be destroyed five years from the collection date. All data will be treated with the strictest confidence in the raw form.

9. How will the results of the study be published?

The findings of the study will be discussed in my PhD thesis and will be submitted to the School of Engineering and ICT. Researcher will maintain a copy of the thesis that includes research findings. Research publications will also be made, as a result of the findings but you will not be identifiable in the publication of the results.

10. What if I have questions about this study?

If you have any enquiry regarding this study, you can approach Adeola Bamgboje at Adeola.Bamgboje@utas.edu.au, Dr. Leonie Ellis at Leonie.Ellis@utas.edu.au or A/Prof. Paul Turner at Paul.Turner@utas.edu.au.

"This study has been approved by the Tasmanian Social Sciences Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study, please contact the Executive Officer of the HREC (Tasmania) Network on +61 3 6226 7479 or email human.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. Please quote ethics reference number [H0014965]."

Thank you for participating in this research study. Your valuable time will greatly benefit the wider community in the future.

You can consent to be involved in this study by completing and signing the consent form provided.

27 APPENDIX R – INFORMATION SHEET FOR FOCUS GROUP PARTICIPANTS

University of Tasmania- School of Engineering and ICT

Participant Information Sheet (version 01) (2005/2016)

An Investigation into Knowledge Optimization in relation to Consumers' Food Management Behaviors

This information sheet is for all participants.

1. Invitation

This research will investigate the role of managing information and knowledge dynamics in relation to Consumers' Food Management Behaviors.

This study is being conducted in partial fulfillment of a PhD Information Systems degree for Adeola Bamgboje in the School of Engineering and ICT. The research is being supervised by Dr Leonie Ellis and A/Prof Paul Turner.

2. What is the purpose of this study?

This research aims to explore the fundamental challenge of how to effectively optimize knowledge to dynamically respond to the diversity of changing consumer attitudes and behaviours. To do this, this research needs insight into your preferences in relation to how information should be presented to you in a mobile phone application.

3. Why have I been invited to participate?

You are being invited to participate in this research because you fit the inclusion criteria advertised for this study. This research is conducting focus group sessions for a user-led design of a food safety mobile phone application in order to generate insights into your requirements for how information should be presented to you.

Your involvement to this study is voluntary and we respect your right to decline to participate.

4. What will I be asked to do?

As a research participant, you will be asked to provide one hour of your time for a focus group session in order to achieve a user-centered design by providing insights into your requirements for the design of the food safety application. The session will be audio recorded. However, your name or any other identifiers will not be recorded or transcribed as part of the data collection. All information will be treated in a confidential manner. All of the research data will be kept at the University of Tasmania in a locked cabinet in the office of the Primary Researcher. All data will be destroyed under appropriate supervision after the mandatory 5-year period.

5. Are there any possible benefits from participation in this study?

It is anticipated that your participation will greatly benefit you as premium food consumer, as well as the Australian food industry as a whole. This research may provide an improved way of providing food safety information to consumers.

6. Are there any possible risks from participation in this study?

There are no anticipated risks that may arise from participating in this study.

7. What if I change my mind during or after the study?

Research participants may choose to withdraw at any time before or during the focus group session without providing an explanation. It is important that you understand that your involvement in this study is voluntary. While we would be pleased to have you participate, we respect your right to decline. There will be no consequences to you if you decide not to participate. If you decide to discontinue participation at any time, you may do so without providing an explanation.

8. What will happen to the information when this study is over?

The data will be kept securely within the School of Engineering and ICT in a digital form. Only the researchers will have access to the raw data. The data will be destroyed five years from the collection date. All data will be treated with the strictest confidence in the raw form.

9. How will the results of the study be published?

The findings of the study will be discussed in my PhD thesis and will be submitted to the School of Engineering and ICT. Researcher will maintain a copy of the thesis that includes research findings. Research publications will also be made, as a result of the findings but you will not be identifiable in the publication of the results.

10. What if I have questions about this study?

If you have any enquiry regarding this study, you can approach Adeola Bamgboje at Adeola.Bamgboje@utas.edu.au, Dr. Leonie Ellis at Leonie.Ellis@utas.edu.au or A/Prof. Paul Turner at Paul.Turner@utas.edu.au

"This study has been approved by the Tasmanian Social Sciences Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study, please contact the Executive Officer of the HREC (Tasmania) Network on +61 3 6226 7479 or email human.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. Please quote ethics reference number [H0014965]."

Thank you for participating in this research study. Your valuable time will greatly benefit the wider community in the future.

You can consent to be involved in this study by completing and signing the consent form provided.

28 APPENDIX S – FIRST ETHICS APPROVAL

Social Science Ethics Officer
Private Bag 01 Hobart
Tasmania 7001 Australia
Tel: (03) 6226 2763
Fax: (03) 6226 7148
Katherine.Shew@utas.edu.au



HUMAN RESEARCH ETHICS COMMITTEE (TASMANIA) NETWORK

26 May 2014

Dr Leonie Ellis
Computing and Information Systems
Private Bag 14

Student Researcher: Adeola Bamgboje

Sent via email

Dear Dr Ellis

Re: MINIMAL RISK ETHICS APPLICATION APPROVAL
Ethics Ref: H0014010 - An Investigation into Food Safety Knowledge Optimization in
Consumer Confidence Improvement

We are pleased to advise that acting on a mandate from the Tasmania Social Sciences HREC, the Chair of the committee considered and approved the above project on 21 May 2014.

This approval constitutes ethical clearance by the Tasmania Social Sciences Human Research Ethics Committee. The decision and authority to commence the associated research may be dependent on factors beyond the remit of the ethics review process. For example, your research may need ethics clearance from other organisations or review by your research governance coordinator or Head of Department. It is your responsibility to find out if the approval of other bodies or authorities is required. It is recommended that the proposed research should not commence until you have satisfied these requirements.

Please note that this approval is for four years and is conditional upon receipt of an annual Progress Report. Ethics approval for this project will lapse if a Progress Report is not submitted.

The following conditions apply to this approval. Failure to abide by these conditions may result in suspension or discontinuation of approval.

1. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval, to ensure the project is conducted as approved by the Ethics Committee, and to notify the Committee if any investigators are added to, or cease involvement with, the project.

A PARTNERSHIP PROGRAM IN CONJUNCTION WITH THE DEPARTMENT OF HEALTH AND HUMAN SERVICES

2. Complaints: If any complaints are received or ethical issues arise during the course of the project, investigators should advise the Executive Officer of the Ethics Committee on 03 6226 7479 or human.ethics@utas.edu.au.
3. Incidents or adverse effects: Investigators should notify the Ethics Committee immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.
4. Amendments to Project: Modifications to the project must not proceed until approval is obtained from the Ethics Committee. Please submit an Amendment Form (available on our website) to notify the Ethics Committee of the proposed modifications.
5. Annual Report: Continued approval for this project is dependent on the submission of a Progress Report by the anniversary date of your approval. You will be sent a courtesy reminder closer to this date. Failure to submit a Progress Report will mean that ethics approval for this project will lapse.
6. Final Report: A Final Report and a copy of any published material arising from the project, either in full or abstract, must be provided at the end of the project.

Yours sincerely,

Katherine Shaw
Executive Officer
Tasmania Social Sciences HREC

29 APPENDIX T – SECOND ETHICS APPROVAL

Social Science Ethics Officer
Private Bag 01 Hobart
Tasmania 7001 Australia
Tel: (03) 6228 2763
Fax: (03) 6228 7148
Katherine.Shaw@utas.edu.au



HUMAN RESEARCH ETHICS COMMITTEE (TASMANIA) NETWORK

10 February 2015

Dr Leonie Ellis
Computing and Information Systems
Private Bag 87

Student Researcher: Adaola Bamgboje

Sent via email

Dear Dr Ellis

Re: MINIMAL RISK ETHICS APPLICATION APPROVAL
Ethics Ref: H0014658 - An Investigation into Food Safety Knowledge Optimization in
Consumer Confidence Improvement: Phase 2

We are pleased to advise that acting on a mandate from the Tasmania Social Sciences HREC, the Deputy Chair of the committee considered and approved the above project on 28 January 2015.

This approval constitutes ethical clearance by the Tasmania Social Sciences Human Research Ethics Committee. The decision and authority to commence the associated research may be dependent on factors beyond the remit of the ethics review process. For example, your research may need ethics clearance from other organisations or review by your research governance coordinator or Head of Department. It is your responsibility to find out if the approval of other bodies or authorities is required. It is recommended that the proposed research should not commence until you have satisfied these requirements.

Please note that this approval is for four years and is conditional upon receipt of an annual Progress Report. Ethics approval for this project will lapse if a Progress Report is not submitted.

The following conditions apply to this approval. Failure to abide by these conditions may result in suspension or discontinuation of approval.

1. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval, to ensure the project is conducted as approved by the Ethics Committee, and to notify the Committee if any investigators are added to, or cease involvement with, the project.

A PARTNERSHIP PROGRAM IN CONJUNCTION WITH THE DEPARTMENT OF HEALTH AND HUMAN SERVICES

2. Complaints: If any complaints are received or ethical issues arise during the course of the project, investigators should advise the Executive Officer of the Ethics Committee on 03 6226 7479 or human.ethics@utas.edu.au.
3. Incidents or adverse effects: Investigators should notify the Ethics Committee immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.
4. Amendments to Project: Modifications to the project must not proceed until approval is obtained from the Ethics Committee. Please submit an Amendment Form (available on our website) to notify the Ethics Committee of the proposed modifications.
5. Annual Report: Continued approval for this project is dependent on the submission of a Progress Report by the anniversary date of your approval. You will be sent a courtesy reminder closer to this date. **Failure to submit a Progress Report will mean that ethics approval for this project will lapse.**
6. Final Report: A Final Report and a copy of any published material arising from the project, either in full or abstract, must be provided at the end of the project.

Yours sincerely

Katherine Shaw
Executive Officer
Tasmania Social Sciences HREC

30 APPENDIX U – THIRD ETHICS APPROVAL

Social Science Ethics Officer
Private Bag 01 Hobart
Tasmania 7001 Australia
Tel: (03) 6226 2763
Fax: (03) 6226 7148
Katherine.Shaw@utas.edu.au



HUMAN RESEARCH ETHICS COMMITTEE (TASMANIA) NETWORK

29 May 2015

Dr Leonie Ellis
School of Engineering and ICT
Private Bag 87

Student Researcher: Adeola Bamgboje

Sent via email

Dear Dr Ellis

Re: MINIMAL RISK ETHICS APPLICATION APPROVAL
Ethics Ref: H0014965 - An Investigation into Food Safety Knowledge Optimization in
Consumer Confidence Improvement: Phase 3

We are pleased to advise that acting on a mandate from the Tasmania Social Sciences HREC, the Chair of the committee considered and approved the above project on 25 May 2015.

This approval constitutes ethical clearance by the Tasmania Social Sciences Human Research Ethics Committee. The decision and authority to commence the associated research may be dependent on factors beyond the remit of the ethics review process. For example, your research may need ethics clearance from other organisations or review by your research governance coordinator or Head of Department. It is your responsibility to find out if the approval of other bodies or authorities is required. It is recommended that the proposed research should not commence until you have satisfied these requirements.

Please note that this approval is for four years and is conditional upon receipt of an annual Progress Report. Ethics approval for this project will lapse if a Progress Report is not submitted.

The following conditions apply to this approval. Failure to abide by these conditions may result in suspension or discontinuation of approval.

1. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval, to ensure the project is conducted as approved by the Ethics Committee, and to notify the Committee if any investigators are added to, or cease involvement with, the project.

A PARTNERSHIP PROGRAM IN CONJUNCTION WITH THE DEPARTMENT OF HEALTH AND HUMAN SERVICES

2. Complaints: If any complaints are received or ethical issues arise during the course of the project, investigators should advise the Executive Officer of the Ethics Committee on 03 6226 7479 or human.ethics@utas.edu.au.
3. Incidents or adverse effects: Investigators should notify the Ethics Committee immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.
4. Amendments to Project: Modifications to the project must not proceed until approval is obtained from the Ethics Committee. Please submit an Amendment Form (available on our website) to notify the Ethics Committee of the proposed modifications.
5. Annual Report: Continued approval for this project is dependent on the submission of a Progress Report by the anniversary date of your approval. You will be sent a courtesy reminder closer to this date. **Failure to submit a Progress Report will mean that ethics approval for this project will lapse.**
6. Final Report: A Final Report and a copy of any published material arising from the project, either in full or abstract, must be provided at the end of the project.

Yours sincerely

Katherine Shaw
Executive Officer
Tasmania Social Sciences HREC

31 APPENDIX V – ANALYSIS OF PHASE TWO FINDINGS

This section presents the analysis and discussion of each of the apps that underwent the consumer evaluation, in terms of the issues with, and benefits of, the existing apps. These formed the basis for which lessons were learnt for the development of the safe food management app.

31.1.1.1 TbA App - Issues

This sub-section discusses the axial codes generated from the card sorting process for the text based app (TbA) in relation to issues with the app. There are four main issues with the app; Design and Aesthetics, Information Content / Functionality, Layout of Information and Platform Compatibility. These will now be discussed.

A. Design and Aesthetics

This refers to the appearance or overall “look and feel” of the app. For this app, the participants were not impressed by the overall appearance of the app. The following quotes show how the app was exactly described by some of the participants.

“Not intuitive to use”/“Unintuitive design”

“Cluttered appearance”

“Ugly – poor layout”

However, this was not surprising because one of the reasons the app was selected is its focus on textual information modality which is important for the context presented in this study.

B. Information Content / Functionality

This involves the completeness of the information being delivered by the app. It is concerned with ensuring the app is indeed useful and that it achieves the purpose for which the user downloaded it in the first place. In this case, the participants believe the app was not very useful as it did not provide all the information they expected. The following quotes reveal how the app was described in this context.

“Provided limited information”

“Limited meat and cut selection”

“Poor information”

Whilst the cooking temperature and recommended cooking time was provided by the app, some of the participants could not locate the cooking time. Therefore, they believed that the cooking time was not provided, as shown in their quotes below.

“Only listed temperature, not times”

“No cooking time given”

Therefore, as long as the users could not locate the required information, they perceived the app as not very useful.

C. Layout of Information

This refers to the information architecture of the app, in terms of how information is layered within the app environment. It determines the experience users have when searching for information. For this app, the participants were not happy with the structure of information because it translated into difficulty in finding information as shown in the quotes below.

“Couldn’t find cooking time”

“Hard to find type of steak”

“Hard to find information”

“Kept taking us to recipes”

This problem highlights the importance of ensuring a well-thought out information architecture when designing an app.

D. Platform Compatibility

This is concerned with the ability of the app to work in multiple mobile operating system environments. The importance of this code stems from the fact that there are various types of smartphones and users should not have to worry about the compatibility of the app with their phone. In this case, some participants were not happy with the app because it was not compatible with their smartphone as shown in the quote below.

“Was not accessible on recent Android”

In this case, the group with this participant had to utilise the smartphone of the other member of the group, since they were working in pairs.

31.1.1.2 TbA App - Benefits

This sub-section discusses the axial codes generated from the card sorting process for the text based app (TbA) in relation to the benefits or positive features of the app. There are five main positive features of the app; Accessibility, Context of Picture Use, Locating Information and No Cost to Users and Value Add. These will now be discussed.

A. Accessibility

This involves the level of ease with which users can find the app, download it, and start using it without unnecessary hiccups. In this case, the participants believed the app was easily accessible to them as shown in the quotes below.

“It was quick to use”

“Quick to download”

“It was accessible on iPhone”

B. Context of Picture Use

This is concerned with the applicability of an image or picture in relation to the context for which it was provided. Despite the fact that it was mainly a text-based app, the background of about half of each page was filled with different pictures. Though such pictures were regarded as a positive feature of the app, it was not without mixed feelings as shown in the quotes below.

“Nice app image but that image was not in the app”

“The distracting background picture was pretty”

“I got some laughs out of it”

Whilst it is usually believed that pictures are pleasing to users, the context for which the pictures are used is quite important as it may well be a double edged sword.

C. Locating Information

This refers to the ease with which users can navigate through the app but more importantly, to retrieve the required information. For this app, the users found it easy to get the information needed from the app because it was straightforward to use. The following quotes reveal how the app was described in relation to this code.

“Simple to use”

“Easy to select the cut from what was listed”

D. No Cost to Users

This is concerned with the cost implication of getting the app. The participants described the app as “free” because they did not make any payment to acquire the app. However, it is believed that the participants made this comment because they were out of positive comments for the app. This belief is based on the fact that such comments were not made for the other apps despite the fact that they were also free.

E. Value add

This involves the extra pieces of useful information being delivered which is beyond the core requirements of the app. It is concerned with ensuring the app does not only achieve the purpose for which the user downloaded it in the first place but provides more value for the user. In this case, the participants liked the app because it provided other information that would be useful to them as shown in the quotes below.

“A variety of meats”

“Variety of different meats (beef, pork, veal, chicken)”

“Had links to recipes”

Though the question posed to the participants (*see sections 5.3.3.2 and 5.3.3.3*) for the TbA app focused on beef steaks, it was however remarkable to note that they were interested in the extra value the app could provide – beyond beef only.

31.1.1.3 PTA App - Issues

This sub-section discusses the axial codes generated from the card sorting process for the pictures and text based app (PTA) in relation to issues with the app. There are four main issues with the app; Context of Picture Use, Layout of Information, Locating Information and Information Content / Functionality. These will now be discussed

A. Context of Picture Use

This is concerned with the applicability of an image or picture in relation to the context for which it was provided. In this app, the image of an animal was used to deliver information about the different cuts of meat. The challenge faced stems from the fact that it was based on either the assumption that the users would know where different cuts are placed on an animal or the assumption that the users had the time to search the

animal for the cut they wanted. This led to the picture being seen as curse rather than a blessing, as shown in excerpts below.

“Selection of meat cut was difficult due to animal picture as opposed to list”

“You need to know your way around cuts and where to find them”

“Hard to find cut wanted”

“Have to know where different cuts are on an animal – challenge if you aren’t a cook or butcher”

In this situation, the participants indeed preferred to see a list of the cuts (text-based information), rather than a picture or an image. Therefore, this shows that the use of an image in this case was not necessarily practical.

B. Locating Information

This involves ease with which users can navigate through the app but more importantly, to retrieve the required information. For this app, the participants found it quite difficult to search for information. The following quotes reveal how the app was described in relation to this code.

“Main menu did not load properly and I had to rely on search”

“Not intuitive”

C. Layout of Information

This refers to the information architecture of the app, in terms of how information is layered within the app environment. It determines the experience users have when searching for information. For this app, the participants were not happy with the structure of information because it translated into difficulty in finding information as shown in the quotes below.

“Information hard to find; therefore, frustrating”

“Search did not recognise words like beef, lamb - only cuts”

How information is layered within the app (Layout of information) is a precursor to user experience when trying to locate information (Locating Information) within the app.

D. Information Content / Functionality

This involves the completeness of the information being delivered by the app. It is concerned with ensuring the app is indeed useful and that it achieves the purpose for which the user downloaded it in the first place. In this case, the participants believe the app was not very useful as it did not provide all the information they expected. The following quotes reveal how the app was described in this context.

“No useful information given”

“There was some lack of information”

Whilst the recommended cooking time was provided by the app, some of the participants could not locate the cooking time. Therefore, they believed that the cooking time was not provided, as shown in their quotes below.

“Didn’t have timings”

“Lacked a time specific suggestion”

“No specific timings as in cooking times”

“Wanted BBQ – but it didn’t tell me cooking time or temperature”

Whilst the specific scenario for this app was focused on lamb, the app only suggested that the recommended cooking methods were pan-fry, barbecue and stir-fry for which it provided no temperature as noted by the participants. Therefore, as long as the users could not locate the required information, they perceived the app as not very useful.

31.1.1.4 PTA App - Benefits

This sub-section discusses the axial codes generated from the card sorting process for the picture and text based app (PTA) in relation to the benefits or positive features of the app. There are five main positive features of the app; Accessibility, Design and Aesthetics, Ethical Perception, Context of Picture Use and Value Add. These will now be discussed.

A. Accessibility

This involves the level of ease with which users can find the app, download it, and start using it without unnecessary hiccups. In this case, the participants believed the app was easily accessible to them as shown in the quotes below.

“Free and easy to download”

B. Design and Aesthetics

This refers to the appearance or overall “look and feel” of the app. For this app, the participants were happy with the overall appearance of the app. The following quotes show how the app was exactly described by some of the participants.

“Reasonably intuitive”

“Clear Interface – Pictures”

“Beautiful Design”

“Visually Good”

“Nice layout besides the opening diagram menu”

“Like the opening menu to main gate”

The findings indicate that the participants liked the graphical interface of the app. However, it was mentioned that the animal diagram which was utilised as the main menu was not necessarily a favourite.

C. Ethical Perception

This is concerned with the moral perception of users in relation to animal welfare. For this app, it was interesting to note that the picture of the animal on the main menu created mixed feelings. Apart from the fact that the image was not very helpful when selecting cuts, as discussed in the issues with the app, the participants expressed their thoughts that the picture did not give them a good feeling, as shown in the excerpt below.

“Not terrible interface, except for cow/animal picture”

“Pretty in a creep cut up animal way”

Perhaps, this is due to the increasingly accepted perception that animals should not be maltreated or ‘cut-up’. It is also important to note here that these comments were not made by the only vegetarian amidst the participants. Therefore, these comments are not necessarily positive and should have been mentioned as one of the issues with the app.

D. Context of Picture Use

This is concerned with the applicability of an image or picture in relation to the context for which it was provided. In this app, the image of an animal was used to deliver

information about the different cuts of meat. The participants however liked the image because it informed them about the different cuts of meat, as shown in excerpts below.

“I liked the animal layout because it is educational but there is scope for improvement”

“Diagram okay”

“Cuts diagram”

“Animal breakdown and information on cuts was good”

For the purpose of educating consumers, the animal image was very useful to the participants. However, when the app is being used in a real life situation such as a kitchen scenario as described above, the practicality of the image becomes questionable. Therefore, this shows the importance of ensuring the appropriateness of the context for which an information modality is used.

E. Value Add

This involves the extra pieces of useful information being delivered which is beyond the core requirements of the app. It is concerned with ensuring the app does not only achieve the purpose for which the user downloaded it in the first place but provides more value for the user. In this case, the participants liked the app because it provided other information that would be useful to them as shown in the quotes below.

“Interesting recipe suggestions”

“Liked to go to recipes, if you wanted, with a selection of meat”

“Recipes were interesting”

Whilst the app generally gave cooking tips, the participants were impressed and perhaps pleasantly surprised when they found the recipes and thus regarded it as an added value to the app.

31.1.1.5 InA App - Issues

This sub-section discusses the axial codes generated from the card sorting process for the integrated app (InA) in relation to issues with the app. There are five main issues with the app; Accessibility, Context of Sound Use, Familiarity, Information Content / Functionality and Value Add. These will now be discussed.

A. Accessibility

This involves the level of ease with which users can find the app, download it, and start using it without unnecessary hiccups. In this case, the participants believed the app was not easily accessible to them as shown in the quote below.

“Took a long time to download”

B. Context of Sound Use

This is concerned with the applicability of a sound or an audible prompt in relation to the context for which it was provided. Whilst the integrated app had all the information modalities (text, picture and sound), the provision of sound prompts was considered undesirable by the participants as shown in the quotes below.

Had annoying “favourites” prompt when choosing to cook a second steak

The queue feature was unnecessary

C. Familiarity

This refers to the first impression experience users have once the app is launched. It involves the level of ease with which users relax into and get acquainted with the app. In this case, the participants were overwhelmed by the landing page of the app once it was launched, as shown in the excerpts below.

“Think you need an opening page”

“Need to explore but then good”

“Initially, not easy to work out”

“Opening ‘how to use’ confusing”

The findings reveal that an app without an opening page may appear confronting to the users, thus making it difficult to get accustomed to the app, most especially on first use.

D. Information Content / Functionality

This involves the completeness of the information being delivered by the app. It is concerned with ensuring the app is indeed useful and that it achieves the purpose for which the user downloaded it in the first place. In this case, the participants believe the app fell short as they thought it did not provide all the information they expected. The following quotes reveal how the app was perceived by the participants.

“Temperature could have been provided below time”

“Lacked temperature information”

“Could not find a recommended temperature to cook my steak”

“Doesn’t list temperature with cooking time”

“Temperatures could be a little more accurate”

Whilst the recommended cooking temperature was indeed provided by the app, some of the participants could not locate it. Therefore, as long as the users could not locate the required information, they perceived the app as not very useful.

E. Value Add

This involves the extra pieces of useful information being delivered which is beyond the core requirements of the app. It is concerned with ensuring the app does not only achieve the purpose for which the user downloaded it in the first place but provides more value for the user. In this case, the participants were not happy with the app because it did not provide other information that might have been useful to them as shown in the quotes below.

“Only steak”

“Little variety of meat (beef only)”

“Only beef”

Though the question posed to the participants (*see sections 5.3.3.2 and 5.3.3.3*) for the InA app focused on beef steaks, it was however remarkable to note that they were interested in the extra value the app could provide – beyond beef only. However, one of the participants noted that they did not see this as a problem because the name of the app indeed portrayed that it focused on beef only.

31.1.1.6 InA App - Benefits

This sub-section discusses the axial codes generated from the card sorting process for the integrated app (InA) in relation to the benefits or positive features of the app. There are four main positive features of the app; Design and Aesthetics, Ease of Use, Information Content / Functionality and Information Tone. These will now be discussed.

A. Design and Aesthetics

This refers to the appearance or overall “look and feel” of the app. For this app, the participants were happy with the overall appearance of the app. When asked about what the participants like about the app, the quotes below reveal their responses.

“The Design”

“Clear Interface”

“Choice of Colours”

The findings indicate that the participants liked the interface of the app. It was also interesting to note that the colour scheme was perceived as a positive feature.

B. Information Content / Functionality

This involves the completeness of the information being delivered by the app. It is concerned with ensuring the app is indeed useful and that it achieves the purpose for which the user downloaded it in the first place. In this case, the participants believe the app was very useful as it provided the required information. The following quotes reveal how the app was perceived by the participants.

“Gives timer for what you want”

“Timer and time suggestion”

“Easy to select type of steak and how you want it cooked”

“The information given was relevant”

“Provided the information required”

“Clear information – 4 easy steps”

“Told you what you wanted to know”

“Could input the thickness of the steak”

The findings reveal that the simplicity of the algorithmic method through which information is delivered to the users of the app makes the app desirable.

C. Information Tone

This refers to the level of encouragement provided by the style or tone of the information being presented to the users of the app. For this app, the participants were happy with the language used in presenting information as shown in the quote below.

“Friendly to use; reassuring information”

D. Locating Information

This is concerned with the ease with which users can navigate through the app and to retrieve the required information. For this app, the participants found it easy to search for information. The following quotes reveal how the app was described in relation to this code.

“Very easy to use (measly foolproof)”

“Intuitive”

“Easy to use”

“Easy access to information”

“Simple to use”

“Fast not too many pages to find information”

Therefore, the findings indicate a positive overall experience from the participants whilst using the app.

32 APPENDIX W - THEMES GENERATED FROM THE CONSUMER-BASED EVALUATION

The themes identified in this phase of the research will be discussed and interpreted while identifying considerations worth noting for the app to be developed. The connection of each axial code to the theme is described in relation to the phase regarding the Design and Development of the Safe Food Management App. The detailed discussion is then supported by the use of interview excerpts and then linked back to the concept of each axial code. At the conclusion of each theme, the association back to the overall intent of this Phase is discussed. The themes and axial codes are discussed in a chronological manner. This phase of the research generated four themes: ACCESS, CONTENT, DESIGN and SEARCH.

32.1.1 Access

Access refers to the level of ease with which an app can be downloaded, installed and used regardless of the smartphone being used by the consumer. The three axial codes that are incorporated into this theme are; *Accessibility*, *No Cost to Users* and *Platform Compatibility*.

Accessibility is connected to ACCESS in that it refers to the speed with which the app can be downloaded.

No Cost to Users connects to ACCESS. This is because a free app can be easily accessible by a broader population of consumers.

Platform Compatibility is related to ACCESS. An app that is platform independent is more broadly accessible by a wider spectrum of consumers.

The axial codes are discussed below and interpreted to generate development considerations for the app being developed.

32.1.1.1 Accessibility

This involves the level of ease with which users can find the app, download it, and start using it without unnecessary hiccups. Accessibility was an issue in the InA app but was regarded as a benefit or positive feature in the TbA and PTA apps. The assessment of both apps was based on the length of download time. The excerpts below show the comments of the users.

“Quick to download” – [TbA App]

“Free and easy to download” – [PTA App]

“Took a long time to download” – [InA App]

Whilst this axial code suggests that it is not advisable for an app to be too big in size, a critical look at the apps reveal that the InA is indeed the smallest in size (15.2MB) whilst the other apps are much bigger. Thus, it indicates that the length of time it took the InA app to download was not necessarily caused by the size of the app as the quality of the network connection (2G, 3G or Wi-Fi) and the number of apps being downloaded at the same time may be factors that contribute to the download speed of the app.

32.1.1.2 No Cost to Users

This is concerned with the cost implication of getting the app. For all three apps, there was no cost to the users in acquiring the app. Therefore, users could download the app without financial implications. The feature was specifically mentioned by participants in relation to the TbA app and described as ‘free’. However, it was not mentioned for the other 2 apps despite the fact that they were both free as well. Perhaps, this is due to the limited number of positive features the users were able to identify for the TbA app.

Although the axial code suggests that free apps are more accessible to consumers, it also indicates that the text based app (TbA) is not very appealing to the users. Therefore, the app to be designed should sparingly incorporate features from the app, if necessary.

32.1.1.3 Platform Compatibility

This refers to the ability of the app to work in multiple mobile operating system environments. Platform compatibility was an issue for the TbA app as some Android-based smartphones were not able to download the app. This axial code was not mentioned in relation to the benefits of any of the apps. The excerpt below shows the comment of the users in relation to this axial code.

“Was not accessible on recent Android” – [TbA App]

This axial code indicates another limitation of the TbA app. It also suggests that the app being designed should be compatible with multiple platforms, so as to broaden the access consumers will have to the app.

The axial codes in this theme ACCESS have illustrated the factors that define the level of ease with which an app can be downloaded, installed and used. ACCESS is the theme that explores the level of ease with which an app can be downloaded, installed and used regardless of the smartphone being used by the consumer. This theme described the axial codes *Accessibility*, *No Cost to Users* and *Platform Compatibility*.

ACCESS provides an overview of the factors that determine how easy it would be for consumers to have the opportunity to use the app and benefit from it. The theme reveals that it is imperative for the size of the app to be taken into consideration when the app is being developed to ensure download speed was acceptable to the users. Regardless of the size and download speed of the app, if the app has some cost implication, there is tendency for some users not to download the app in the first instance. Even when the download speed is right, and the app is free to users, it can only be downloadable if the app is compatible with the smartphone of the user, thereby providing ACCESS to the app.

32.1.2 Content

Content refers to all the considerations required when communicating and delivering information to the users through the app. The four axial codes that are incorporated into this theme are; *Ethical Perception*, *Information content/Functionality*, *Information Tone* and *Value Add*.

Ethical Perception is related to CONTENT. For all information being delivered by the app, it is important to consider how it is ethically perceived by the consumers to facilitate its acceptance without reservations.

Information content / Functionality connects to CONTENT as it is concerned with ensuring the app contains all the actual information required by the users of the app. This ensures that the app is indeed functional and useful.

Information Tone relates to CONTENT in that it is important to consider the style or language used in communicating with the users of the app. A positive tone tends to encourage the users in following the instructions provided by the app.

Value add is connected to CONTENT. This consideration is about providing information that is just more than the required which may be useful to the users.

The axial codes are discussed below and interpreted to generate development considerations for the app being developed.

32.1.2.1 Ethical Perception

This is concerned with the moral perception of users in relation to animal welfare. Ethical perception was an issue for the PTA app as the animal image on the app aimed at providing information about the different meat cuts had polarising views from the users. This perception is perhaps due to the recent conversations about animal welfare in Australia. The quote below shows the comment of the users in relation to this axial code.

Not terrible interface, except for cow/animal picture – [PTA app]

Pretty in a creep cut up animal way – [PTA app]

Whilst the intention of using the animal image was for the purpose of delivering information about different meat cuts, it received polarising thoughts from the users. Perhaps, the same goal could have been achieved differently so as to ensure acceptance without reservations.

32.1.2.2 Information Content / Functionality

This involves the completeness of the information being delivered by the app. It is concerned with ensuring the app is indeed useful and that it achieves the purpose for which the user downloaded it in the first place. Information content / functionality was an issue for the TbA, PTA and InA apps as expressed by the participants. The comments of the participants are shown in the excerpts below.

“Provided limited information”- [TbA App]

“Limited meat and cut selection”- [TbA App]

“There was some lack of information”- [PTA App]

“Lacked a time specific suggestion”- [PTA App]

“Temperature could have been provided below time”- [InA App]

“Could not find a recommended temperature to cook my steak”- [InA App]

However, it is also interesting to note that information content was also regarded as a benefit or positive feature for the InA app as the provided steps were simple, moderately interactive and the information was easily adaptable to the context of the user as shown in the quotes below.

“Provided the information required” - [InA App]

“Clear information – 4 easy steps” - [InA App]

“Told you what you wanted to know” - [InA App]

“Could input the thickness of the steak” - [InA App]

The comments provided by the participants regarding the TbA and the InA app is not accurate, as the apps indeed provided the required information (see Chapter 7). The problems stems from the fact that some of the participants could not locate such some of the information provided. However, for the PTA app, the recommended cooking times were provided for the suggested recipes based on cooking methods that did not necessary require the use of a thermometer. Nonetheless, the app could have provided more information such as cooking temperature and times for all the other cooking methods.

32.1.2.3 Information Tone

This refers to the level of encouragement provided by the style or tone of the information being presented to the users of the app. Information tone was a benefit or positive feature for the InA app as expressed by the participants in the quote below.

“Friendly to use; reassuring information” - [InA App]

Instructions provided by the InA app had a positive and supportive tone associated with it. Therefore, it was easy for the users to follow the instructions without any problem. This is an important consideration when deciding how instructions or messages are worded in the app being developed.

32.1.2.4 Value Add

This involves the extra pieces of useful information being delivered which is beyond the core requirements of the app. It is concerned with ensuring the app does not only achieve the purpose for which the user downloaded it in the first place but provides more value for the user. Value add was considered as a benefit for the TbA and PTA apps as the provided information about other types of meat and recipe information respectively. The comments from participants are shown in the excerpt below.

“Variety of different meats (beef, pork, veal, chicken)” - [TbA App]

“Interesting recipe suggestions” - [PTA App]

However, value add was considered an issue for the InA app as it only provided information about beef only as shown in the participants quotes below.

“Little variety of meat (beef only)”- [InA App]

Some of the participants considered this as an issue despite the fact that the name of the app clearly suggests that the app focuses on beef only. However, during this discussion, one of the participants indeed stated that it should not be regarded as an issue because the app delivered what it promised.

The axial codes in this theme CONTENT have illustrated the appropriate considerations that should be taken into account when designing and developing the app. CONTENT is the theme that explores all the concerns that should be considered when communicating and delivering information to the users through the app. This theme described the axial codes *Ethical Perception*, *Information content/Functionality*, *Information Tone* and *Value Add*.

CONTENT provides an overview of the important elements that require attention in relation to how information is communicated and delivered to the app users. The theme reveals that the app should deliver on all the information it is required to provide its users to ensure the functionality of the app. Moreover, it is valuable if other related information that may also be beneficial to the users is provided in the app; thus adding value. In addition, the theme indicates that the tone through which information is provided is also important to the user as this influences the level of acceptance of the contents of the app. Finally, it also reveals that it is imperative to ensure the information being delivered by the app through text, images, sound or video should be critically assessed to avoid contradictory perception from the users.

32.1.3 Design

Design refers to the artistic strategies in place that makes the app, not only visually appealing but pleasant to use. The four axial codes that are incorporated into this theme are; *Context of Picture Use*, *Context of Sound Use*, *Design and Aesthetics* and *Familiarity*.

Context of Picture Use is connected with DESIGN. Pictures or images are one of the important strategies used to make an app look attractive. However, while designing the

app, it is important to ensure the pictures that will be used are appropriate and that they serve a direct goal.

Context of Sound Use relates to DESIGN. In an app, audible prompts or sounds are sometimes useful in attracting the attention of the user. However, when making development considerations, all potential prompts or sounds must be critically assessed to ensure it achieves only the intended goal.

Design and Aesthetics is connected to DESIGN as it involves ensuring that the app is pleasant to use and attractive to the user.

Familiarity is related to DESIGN in that it is involved with ensuring that first time users easily get acquainted with the app without much effort. This has to be built into the app during the design phase.

The axial codes are discussed below and interpreted to generate development considerations for the app being developed.

32.1.3.1 Context of Picture Use

This is concerned with the applicability of an image or picture in relation to the context for which it is provided. Context of picture use was regarded as an issue for the PTA app. Whilst it was regarded as a benefit for both the TbA app, the findings reveal that it was not necessarily a desired feature as shown in the excerpts below.

“The distracting background picture was pretty”- [TbA App]

“Selection of meat cut was difficult due to animal picture as opposed to list”- [PTA App]

Although the users considered the animal picture in the PTA app as an issue, it was also regarded as a benefit or positive feature for the app. This is due to the educative purpose the picture achieves, which may have been the intended use of the app.

“I liked the animal layout because it is educational but there is scope for improvement”- [PTA App]

“Animal breakdown and information on cuts was good”- [PTA App]

Perhaps, both purposes could have been achieved if there were separate pages addressing separate issues; with one page providing cooking guidance on how to cook

different meat types or cuts while another page educates the users on how the meat cuts can be identified.

32.1.3.2 Context of Sound Use

This is concerned with the applicability of a sound or an audible prompt in relation to the context for which it was provided. Context of sound use was regarded as an issue for the InA app being the only app that integrated all three information modalities (text, picture, sound) in the study. The findings reveal that the participants were not necessarily impressed by the sound prompts as shown in the quotes below.

Had annoying “favourites” prompt when choosing to cook a second steak – [InA App]

The queue feature was unnecessary – [InA App]

Whilst the app appeared sophisticated with the sound cues aimed at facilitating action, the feature was not appealing to the users. Therefore, it is preferable if the app does not include sound prompts in a way that can annoy the user.

32.1.3.3 Design and Aesthetics

This refers to the appearance or overall “look and feel” of the app. The design and aesthetics was considered an issue for the TbA app as its appearance was not appealing. However, this was expected because the design of the app mainly focused on text as an information modality. The excerpts below reveal the perception of the users to the app.

“Not intuitive to use”/“Unintuitive design” - [TbA App]

“Cluttered appearance” - [TbA App]

“Ugly – poor layout” - [TbA App]

However, the design and aesthetics were considered as a benefit or positive feature for both the PTA and InA apps as shown in the excerpts below.

“Reasonably intuitive” - [PTA App]

“Beautiful Design” - [PTA App]

“Visually Good” - [PTA App]

“Clear Interface” - [InA App]

“Choice of Colours” - [InA App]

The findings in this axial code reveals the importance of an appealing visual presentation of the app to be developed, in terms of the choice of colours, layout, intuitiveness as well as the overall ‘look and feel’.

32.1.3.4 Familiarity

This refers to the first impression experience users have once the app is launched. It involves the level of ease with which users relax into and get acquainted with the app. Familiarity is considered an issue for the InA app as shown in the excerpts below.

“Think you need an opening page” - [InA App]

“Need to explore but then good” - [InA App]

“Initially, not easy to work out” - [InA App]

“Opening ‘how to use’ confusing” - [InA App]

Whilst the InA app is visually appealing, the problem stems from the landing page of the app as it does not introduce the users to the environment neither does it provide straightforward information about how to use the app. Therefore, on launching the app, the very first screen or page is confronting and overwhelming for the users as they need to explore before knowing their way around the app. Therefore, this finding reveals that it is important to have a landing page for the purpose of introducing the users into the app environment to facilitate some level of familiarity.

The axial codes in this theme DESIGN have illustrated the strategies that should be considered to ensure a high standard of usability and desirability for the app. DESIGN is the theme that explores the artistic strategies in place that makes the app, not only visually appealing but pleasant to use. This theme described the axial codes *Context of Picture Use, Context of Sound Use, Design and Aesthetics and Familiarity*.

DESIGN provides an overview of the strategies and features that can influence the appearance of the app. This theme reveals that the use of pictures and images in an app is a desirable feature for end users; however, the context for which the picture is provided has to be critically considered. Also, in the design of an app, such as the context defined in this study, sound prompts are not necessarily desirable to users especially when trying to accomplish a task in the kitchen as this mode of information has the tendency to distract the users of the app. In addition, one of the important

features that should be incorporated is a landing page which familiarises the users with the app environment first as this is a feature that increases its usability. Finally, this theme also reveals that attention has to be paid to the appearance of the app in terms of the choice of colours, layout, intuitiveness and the overall ‘look and feel’ of the app.

32.1.4 Search

Search refers to the factors that impact the user’s ability to explore the app to retrieve the required information without wasting time or getting frustrated. The two axial codes that are incorporated into this theme are; *Layout of Information*, and *Locating Information*.

Layout of information is connected to SEARCH as it is concerned with the structure through which information is layered within the app environment. This influences the search process of the users of the app.

Locating Information relates to SEARCH. It concerns the ease with which users can explore the app for the purpose of retrieving information, thus influencing the search process within the app.

The axial codes are discussed below and interpreted to generate development considerations for the app being developed.

32.1.4.1 Layout of Information

This refers to the information architecture of the app, in terms of how information is layered within the app environment. It determines the experience users have when searching for information. Layout of Information was considered as issues for the TbA and PTA apps as shown in the excerpts below.

“Hard to find information” - [TbA App]

“Kept taking us to recipes” - [TbA App]

“Information hard to find; therefore, frustrating” - [PTA App]

“Search did not recognise words like beef, lamb - only cuts” - [PTA App]

The findings reveal that the structure of the information within the apps was not appropriate thus leaving users feeling frustrated during the search process. This axial code has a heavy influence on the following axial code – locating information due to

their inter-relatedness. The layout of information is a pre-cursor and it determines the experience of users during the search process.

32.1.4.2 Locating Information

This refers to the ease with which users can navigate through the app but more importantly, to retrieve the required information. Locating information was considered an issue for the PTA app but a benefit for both the TbA and InA apps as shown in the excerpts below.

“Main menu did not load properly and I had to rely on search”- [PTA App]

“Not intuitive”- [PTA App]

“Simple to use”- [TbA App]

“Easy to select the cut from what was listed”- [TbA App]

“Easy access to information”- [InA App]

“Intuitive”- [InA App]

“Fast not too many pages to find information”- [InA App]

It was however interesting to note that the text based app (TbA) was easier to use when compared to the pictures and text based app (PTA). Perhaps, this was due to the layout of information as discussed in the preceding axial code.

The axial codes in this theme SEARCH have illustrated the elements that one should take into consideration which could potentially influence user experience in relation to information search and retrieval within the app. SEARCH is the theme that explores the factors that impact the user's ability to explore the app to retrieve the required information without wasting time or getting frustrated. This theme described the axial codes *Layout of Information, and Locating Information*.

SEARCH provides an overview of the factors affecting user experience when exploring and retrieving information from an app. This theme reveals the importance of the structure or layers of information within the app as it has the potential to influence the level of ease with which users can navigate through the app to retrieve information. Therefore, it indicates that information architecture influences users experience in relation to information search and retrieval within the app environment.

33 APPENDIX X – CONCEPT DESIGN

Based on the findings from the heuristic and consumer evaluations conducted on all three apps (TbA, PTA and InA), this section provides a finalised high fidelity prototype; having learnt from user preferences and experiences with the existing apps. The details of the concept design, in terms of the app content, app platforms, home screen, preparation or cooking information, important safe preparation tips, guide to correct cooking temperatures, special rules for barbecues, specific cooking help, reheating left overs and meat thermometers is presented here.

33.1.1 App Content

The Australian Meat Safety (TAMS) app is designed to provide information about how Australian food consumers can safely manage meat products from the point of purchase till actual consumption. The idea of the app is based on the findings of the survey which reveals that some Australian consumers lack the knowledge required to safely manage their meat products after purchase. The content of this app is based on best practice guidelines provided by the following agencies;

- Commonwealth Scientific and Industrial Research Organisation (CSIRO)
- Food Safety Information Council (FSIC)
- Food Standards Australia New Zealand (FSANZ)
- Meat and Livestock Australia (MLA)
- New South Wales Food Authority (NSWFA)

33.1.2 App Platforms

The app will be developed both on the iOS and Android platforms for iPhone and Android based smartphone users respectively. This is based on development consideration 3 generated from the consumer based evaluations conducted.

33.1.3 Home Screen

Access to the app is gained by searching the app store for the name of the app and downloading it to the user's smartphone. Once it has been downloaded, launching the application opens the home screen. This is based on development considerations 10, 11 and 14 as revealed by the findings of the consumer and heuristic evaluations conducted on the existing apps. The order of the main buttons on the home screen is based on the findings of the survey, which reveals the most problematic areas in which Australian

food consumers practice unsafe meat handling behaviours. The home screen is shown in Figure 34-1.



Figure 33-1: Home screen

33.1.4 Preparation or Cooking Information

Based on the findings of the survey (see Chapter 4), cooking was identified as the most problematic food handling behaviour of the respondents. Therefore, it is emphasised as the first tab on the home screen. Due to its importance, only the prototype related to the preparation tab will be discussed here. Once the preparation tab is tapped, the user sees the preparation page as shown in Figure 34-2.

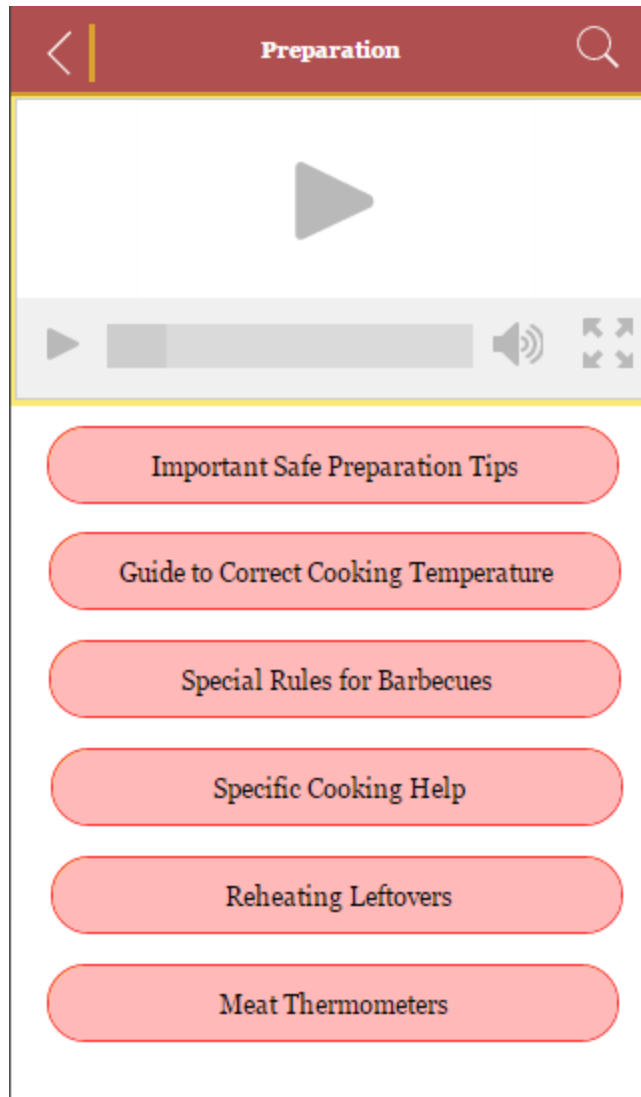


Figure 33-2: Preparation

This page incorporates a video about safe meat preparation tips provided by FSANZ based on development considerations 8 and 9. Sound prompts are deliberately avoided but a video which users can decide to play or not to play is deemed preferable when intending to communicate information effectively. Also, the structure of the information is considered very important based on development consideration 12. For full details on the information architecture of the app, please see Appendix J.

33.1.5 Important Safe Preparation Tips

This is the first tab under the preparation tab as it is considered the most important information that should be communicated with the users within this tab. Once this tab is tapped, the user sees the important safe preparation tips page as shown in Figure 34-3.

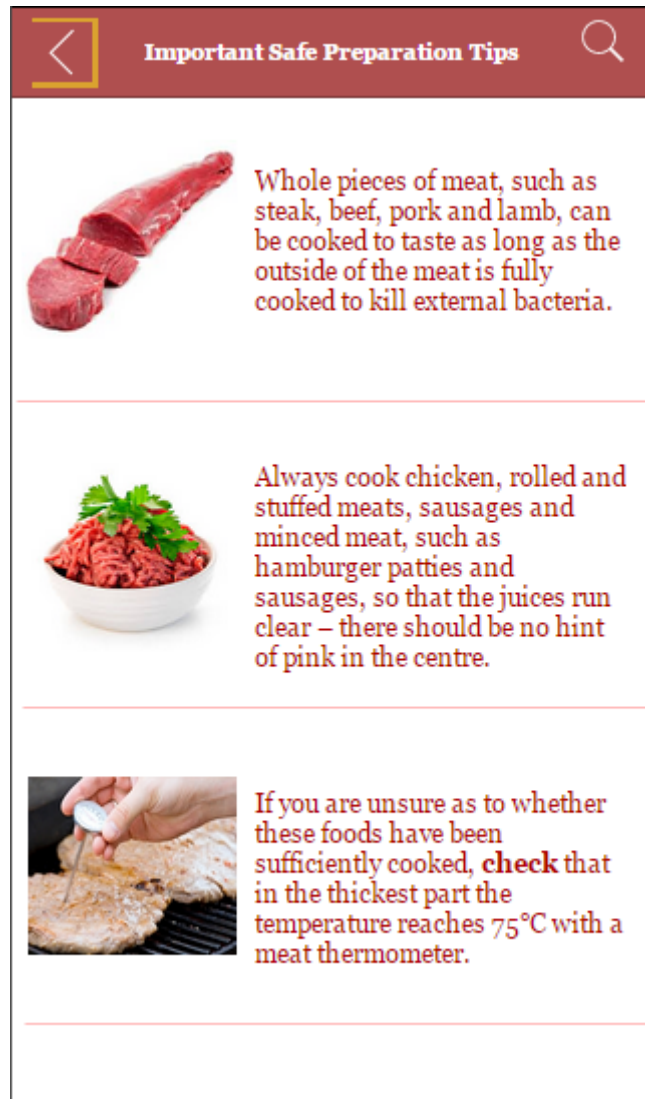


Figure 33-3: Important safe preparation tips

On this page, the user will be able to see a summary of the most important on safe meat preparation, without having to go through many pages. The page also incorporates a search button to provide users with easy access to information, thus adhering to development considerations 12 and 13.

33.1.6 Guide to Correct Cooking Temperatures

This is the second tab under the preparation tab and it provides a quick guide to the correct temperatures for cooking different meat products. As pictures were considered a great way to communicate information, the page delivers information based on the image provided by Food Standards Australia New Zealand (FSANZ) as shown in Figure 34-4.

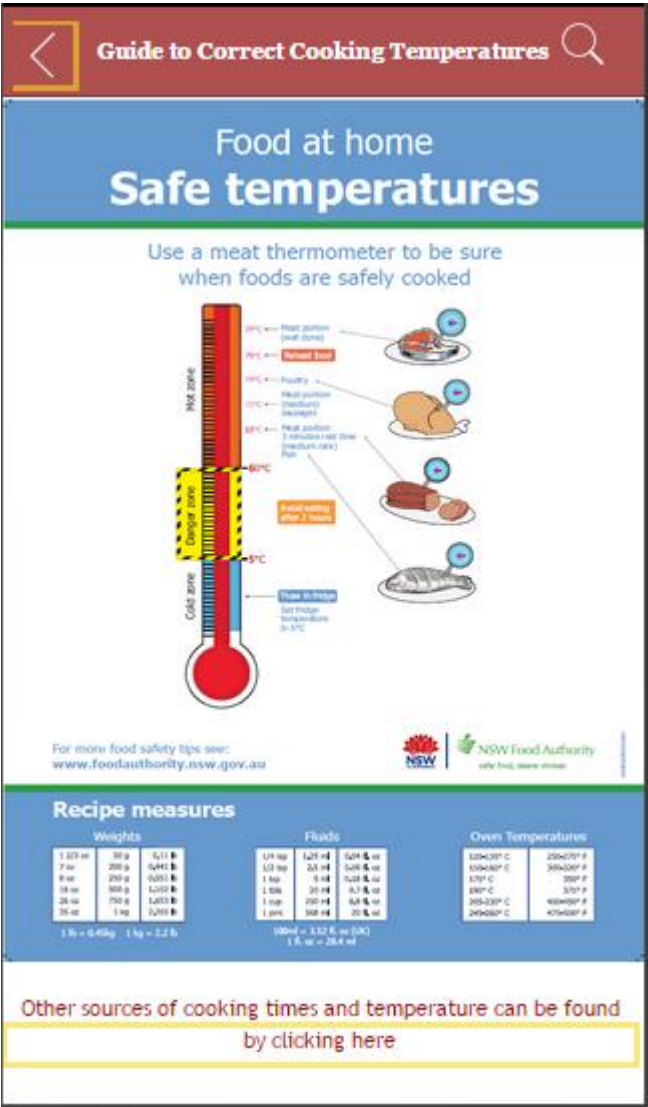


Figure 33-4: Guide to correct cooking temperatures

On this page, an extra source of information was also provided in order to abide by development consideration 7. The page also incorporates a search button to provide users with easy access to information, thus adhering to development consideration 13.

33.1.7 Special Rules for Barbecues

This is the third tab under the preparation tab and it provides safety information about preparing barbecues. Within this page, a video about safety rules for barbecues provided by FSIC based on development considerations 8 and 9 has been incorporated. Whilst it contains a video, there was also a lot of textual information for this section. However, based on development considerations 10 and 15 the prototype was made to ensure the page is not cluttered by splitting the textual information into 3 similar pages as shown in Figure 34-5, 34-6 and 34-7.

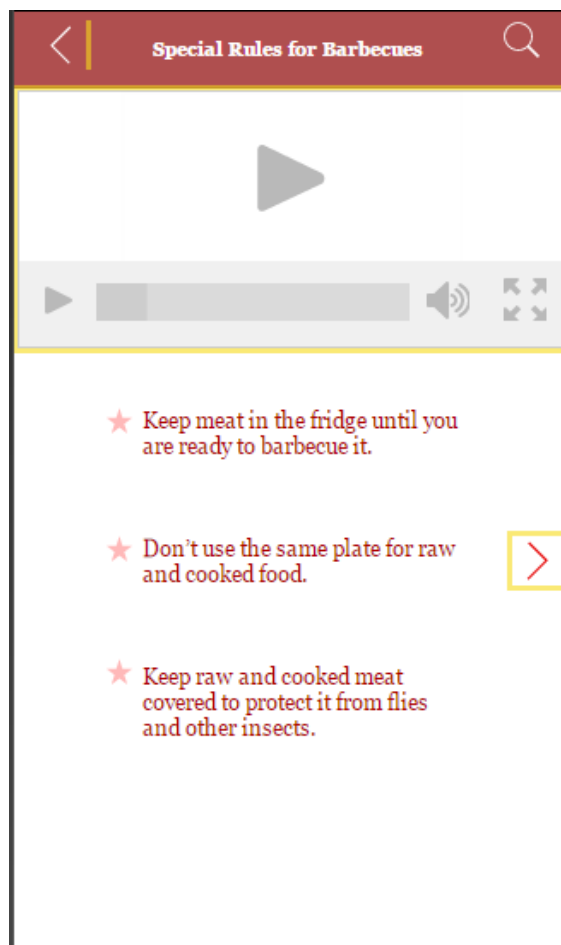


Figure 33-5: Special rules for barbecues 1

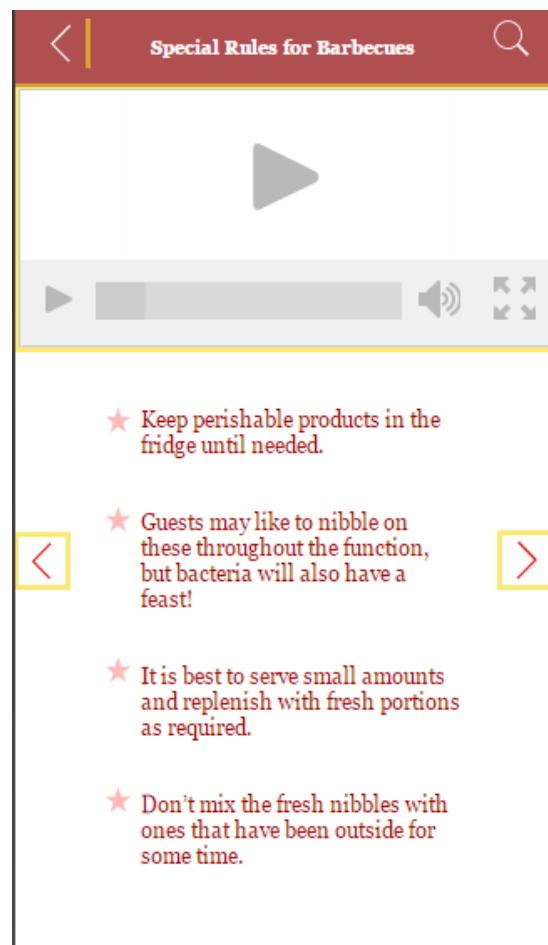


Figure 33-6: Special rules for barbecues 2

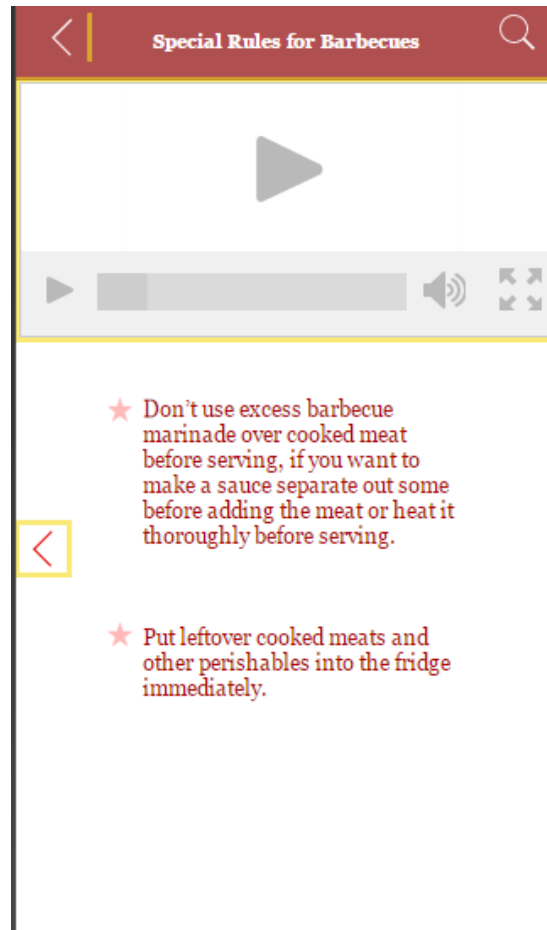


Figure 33-7: Special rules for barbecues 3

33.1.8 Specific Cooking Help

This is the fourth tab under the preparation tab and it provides the link to resources about how to cook various meat products. As the core focus of the app is providing safety information, it was deemed inappropriate to provide information that will be similar to the ones provided by the existing cooking apps used for the scenario-based focus group evaluation presented in Chapter 5.

As earlier specified, this is part of the ways in which careful considerations were made to ensure that copyright restrictions on the existing apps used for this study have been strictly adhered to during the development of this finalised high fidelity prototype as shown in Figure 34-8.

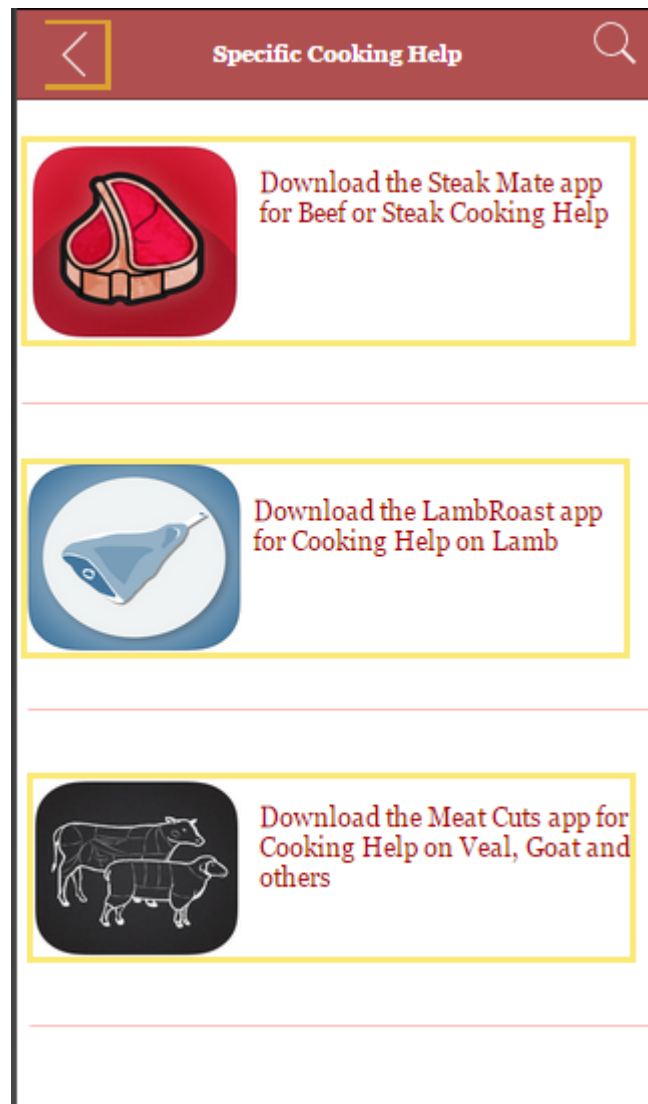


Figure 33-8: Specific cooking help

33.1.9 Reheating Leftovers

This is the fifth tab under the preparations tab and it provides information about how to safely reheat leftovers in the home. To adhere to development consideration 12, this page was deliberately created to provide a clear layer of information for the sub-categories under the 'reheating leftovers' tab: microwave cooking and other reheating tips as shown in Figure 34-9. The aim of this decision was to ensure that users can easily search the app for required information.



Figure 33-9: Reheating leftovers

Whilst the ‘microwave’ section has utilised a picture related to the information being communicated, there was also a lot of textual information for this section. However, based on development considerations 10 and 15, the prototype was made to ensure the page is not cluttered by splitting the textual information into 3 similar pages as shown in Figure 34-10, 34-11 and 34-12.



Figure 33-11: Microwave cooking 1



Figure 33-10: Microwave cooking 2



Figure 33-12: Microwave cooking 3

Within the reheating category, the second tab is about ‘other reheating tips’ as it contained information that was not related to microwave cooking. This page, as shown in Figure 34-13, adheres to development consideration 10 by ensuring that the information presented is not cluttered as it ensures sufficient white space.



Figure 33-13: Other reheating tips

33.1.10 Meat Thermometers

This is the final tab under the preparation tab and it provides information about what a food thermometer is, the types of meat thermometers, how to use a meat thermometer in the home and other useful information about using a meat thermometer. To ensure compliance with development considerations 12 and 13, the information is structured in three parts as shown in Figure 34-14.

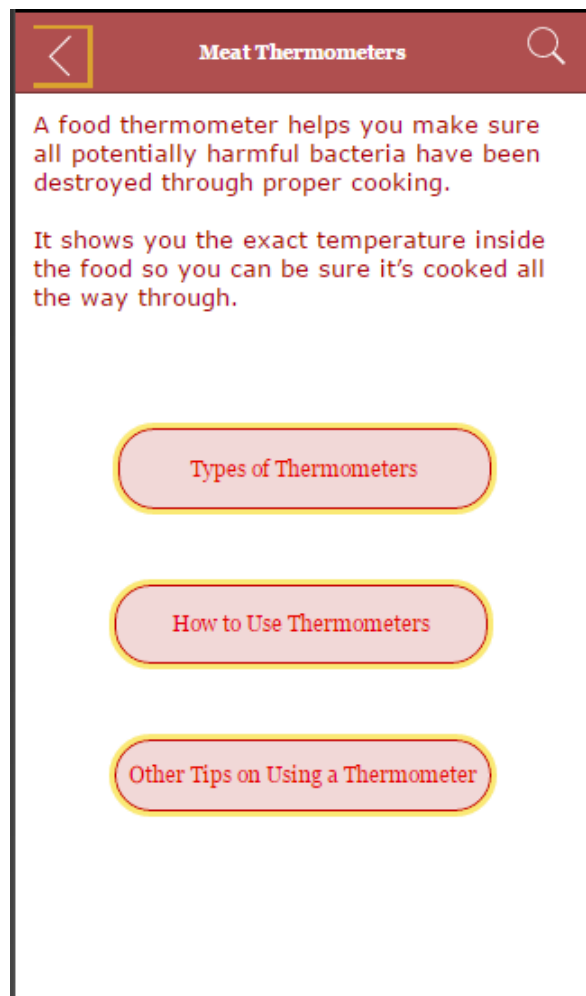


Figure 33-14: Meat thermometers

The first sub-category in this page is a tab on “types of thermometers” which leads to the page showing information about the different types of meat thermometers as shown in Figure 34-15.

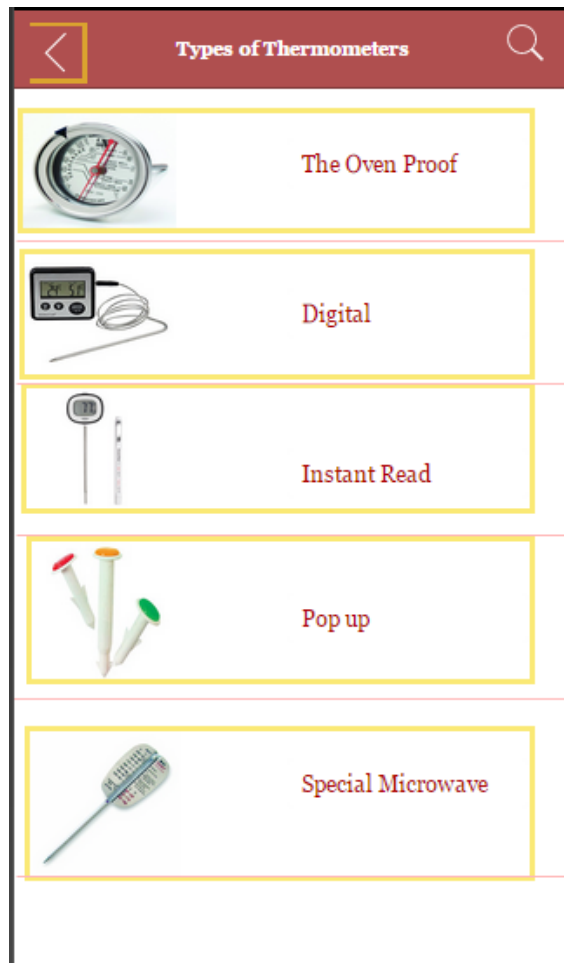


Figure 33-15: Types of thermometers

Clicking on each of the thermometers will reveal information about how it is recommended to use it. Within each of the tabs for the different thermometers, the users can swipe across from one thermometer to the other; thus complying with development consideration 15. Also, based on development consideration 10, the prototype was made to ensure the page is not cluttered by splitting the information on each thermometer into 5 similar pages as shown in Figures 34-16, 34-17, 34-18, 34-19 and 34-20.



Figure 33-16: Oven proof thermometer

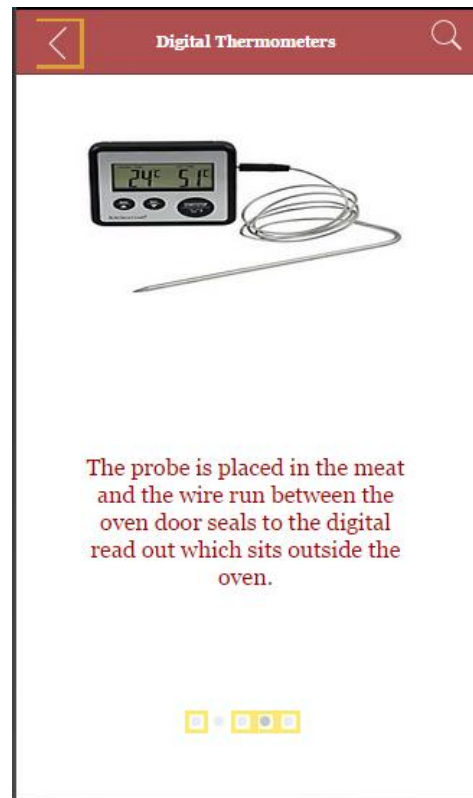


Figure 33-17: Digital thermometer



Figure 33-18: Instant read thermometer

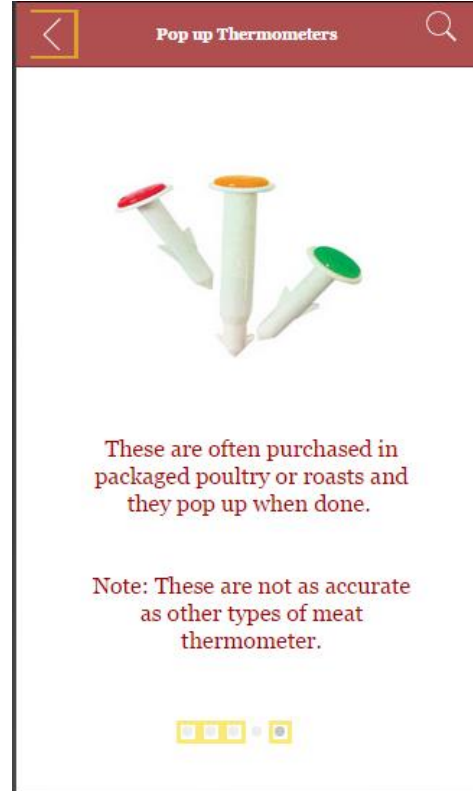


Figure 33-19: Pop up thermometer

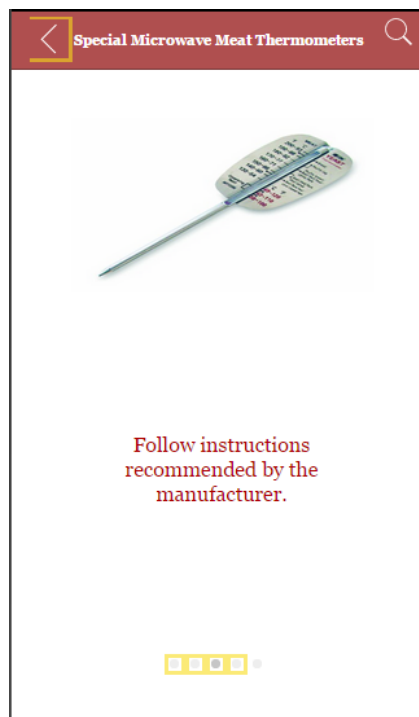


Figure 33-20: Special microwave thermometer

The second sub-category in this page is a tab on “how to use thermometers” which leads to the page showing information about how to use thermometers to determine the temperature of different types of meat as shown in Figure 34-21.



Figure 33-21: How to use thermometers

Clicking on each of the meat types will reveal information about how it is recommended to examine the temperature. Within each of the tabs for the different meat types, the users can tap on and off the tab to show more information or collapse the information; thus complying with development consideration 13. Also, based on development consideration 10, the prototype was made to ensure the page is not cluttered by splitting the information on each thermometer into 5 similar pages as shown in Figures 34-22, 34-23, 34-24 and 34-25.

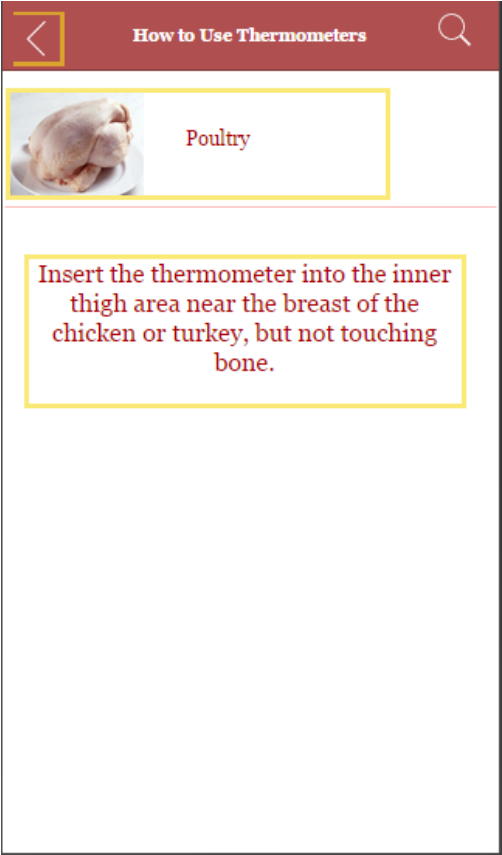


Figure 33-22: Poultry

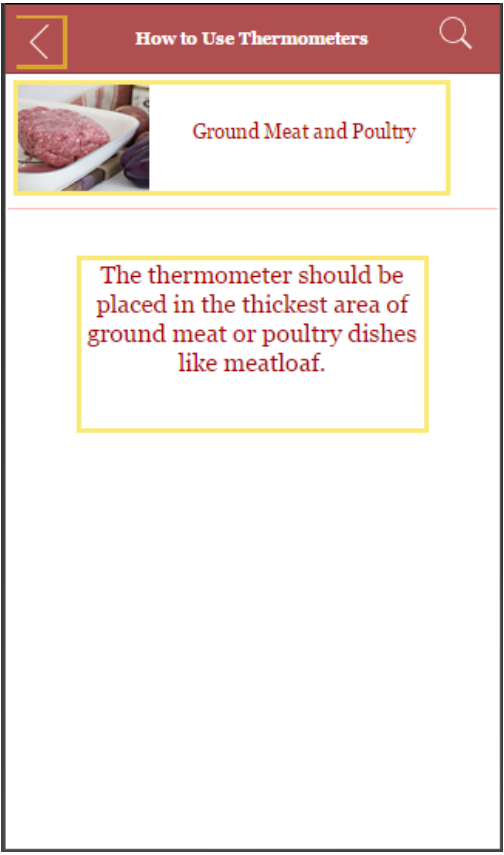


Figure 33-23: Ground meat and poultry

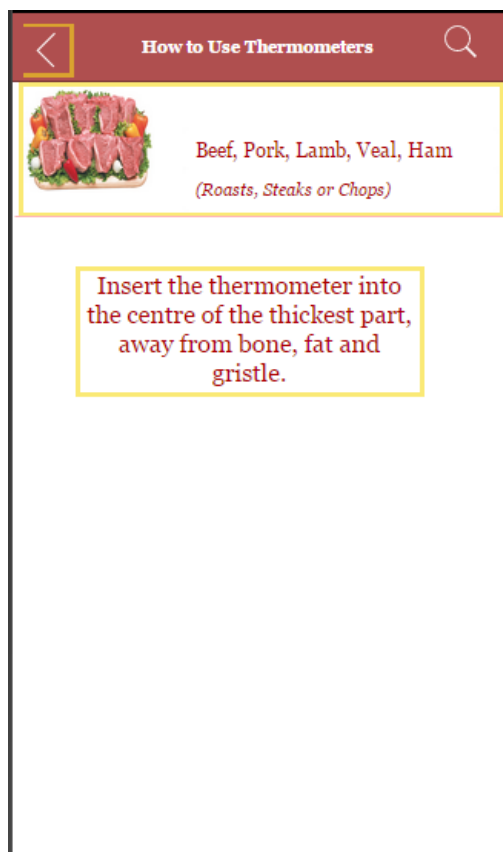


Figure 33-24: Beef, pork, lamb, veal, ham

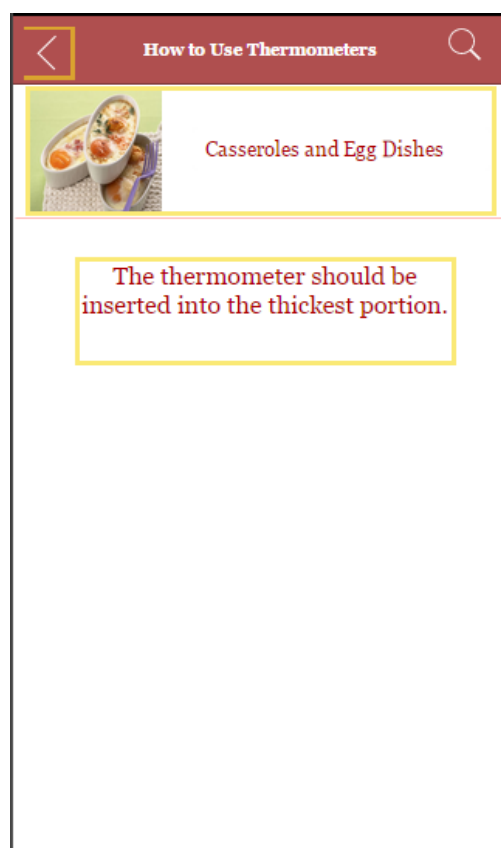


Figure 33-25: Casseroles and egg dishes

The third sub-category on the “meat thermometers” page is a tab on “other tips on using thermometers” which leads to the page showing other information about how to use thermometers which does not necessarily fit within the prior two sub-categories as shown in Figure 34-26. It is believed that this layer of information is more appropriate as it complies with development consideration 13.

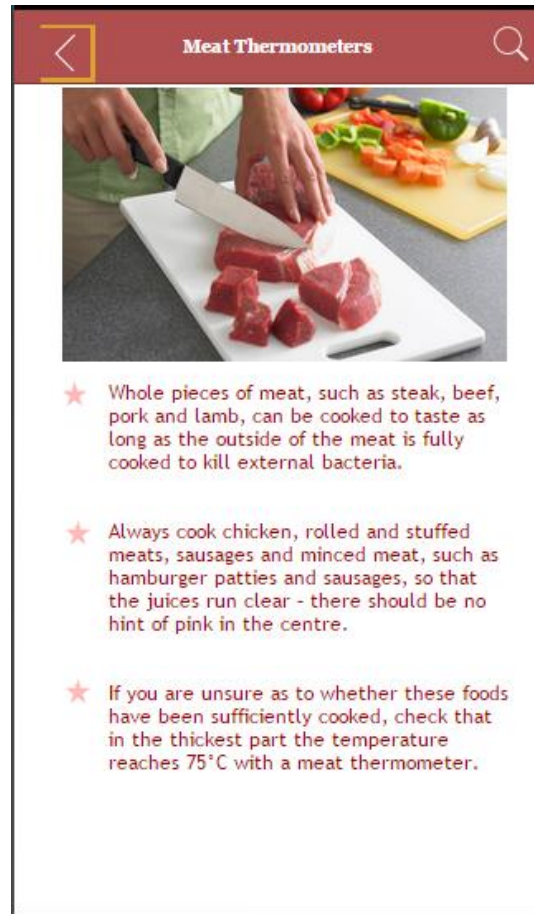


Figure 33-26: Other tips on using meat thermometers

In summary, this section on concept design has provided information about the high fidelity prototype which will be developed as the app. The prototype is strongly aligned with the findings of the research presented in Chapters 4 and 5 and the concepts are based on the development considerations discussed in chapter 5.

34 APPENDIX Y – DETAILS OF FIELD EXPERIMENT RESULTS IN WEEK 3

Tables 34-1 and 34-2 reveal the results of the open-ended questions for question 1 for the experimental group and control group respectively.

Table 34-1: Week 3 results for Question 1 for experimental group

Question 1: Clearly describe two different methods of avoiding cross contamination between the lamb chops and the vegetables				
Recommended Answer	ACJ's response	ACC's response	ACH's response	ACM's response
<p>Method 1: <i>I will thoroughly wash the chopping board and knife with soap and hot water and dry them.</i></p> <p>Method 2: <i>I will use a different knife and a different chopping board.</i></p> <p><i>I will wash my hands with soap and hot water for more than 30 seconds after handling the lamb.</i></p>	<p>Method 1: Wash chopping board and cutting utensils in hot soapy water and either air dry or dry with paper towels. Place vegetables in a clean container away from raw meat.</p> <p>Method 2: Use a different clean chopping board and utensils to chop vegetables avoiding any contact with raw meat.</p>	<p>Method 1: Use a second chopping board and new knife.</p> <p>Method 2: Thoroughly wash chopping board and knife in hot soapy water. Leave to air dry or dry if short of time with paper towel.</p>	<p>Method 1: Wash your hands with soap and hot water for at least 30 seconds and dry with a paper towel. Use a new chopping board and a new knife that has not been used to prepare meat.</p> <p>Method 2: Wash your hands with soap and hot water and dry with a paper towel. Wash the chopping board and knife used to prepare lamb with hot water and dish soap. Let them air dry for a few minutes then use them to chop the vegetables.</p>	<p>Method 1: Wash the knife and the chopping board with hot water and soap, make sure both are cleaned through and then dry it with paper towel. Then start processing the vegetables.</p> <p>Method 2: If you have spare ones, use spare knife and chopping board to process vegetables.</p> <p>PS: Both methods need to make sure hands are clean.</p>
Maximum point is 5	2.5 points	2.5 points	5 points	5 points

Table 34-2: Week 3 results for Question 1 for control group

Question 1: Clearly describe two different methods of avoiding cross contamination between the lamb chops and the vegetables				
Recommended Answer	DCW's response	DCT's response	DCV's response	DCH's response
<p>Method 1: <i>I will thoroughly wash the chopping board and knife with soap and hot water and dry them.</i> <i>I will wash my hands thoroughly with soap and hot water for more than 30 seconds after handling the lamb.</i></p> <p>Method 2: <i>I will use a different knife and a different chopping board.</i> <i>I will wash my hands with soap and hot water for more than 30 seconds after handling the lamb.</i></p>	<p>Method 1: Use a fresh clean and sanitised knife and chopping board. Fresh because they have not yet been used for food preparation since being cleaned and sanitised.</p> <p>Method 2: Clean the knife and chopping board after preparing the lamb in hot soapy water and rinse with hot water and allow to air dry. Once the knife and board are dry, you can process the vegetables.</p>	<p>Method 1: After cutting the lamb, I will cut the veggies with another cut-board and knife.</p> <p>Method 2: I will first cut the knife with the board and then wash them with hot soapy water and then cut the veggies with the board and knife.</p>	<p>Method 1: Wash both knife and chopping board with hot soapy water before cutting the vegetables.</p> <p>Method 2: Use different knife and chopping board to cut the vegetables.</p>	<p>Method 1: Wash the knife and the chopping board with hot water and soap, and dry on paper towel. This removes any bacteria present.</p> <p>Method 2: Use a different cutting board and knife and wash your hands with soap and hot water. This removes any bacteria from your hands and provides a clean work surface.</p>
Maximum point is 5	2.5 points	2.5 points	2.5 points	4 points

Tables 34-3 and 34-4 reveal the results of the open-ended questions for question 2 for the experimental group and control group respectively.

Table 34-3: Week 3 results for Question 2 for experimental group

Question 2: Clearly describe all the steps you would take to preserve the meal till your friend arrives and is ready to eat.				
Recommended Answer	ACJ's response	ACC's response	ACH's response	ACM's response
<p>1. Cool the meat for less than 1 hour. Cover and store the food in the fridge till the friend arrives.</p> <p>2. Reheat till it is steaming hot before serving to friend.</p>	<p>1. If the meat had already been cooked then it should be placed in a covered container in a refrigerator.</p> <p>2. Roast potatoes and salad should be placed in a separate covered container and kept in refrigerator.</p> <p>3. If meat is uncooked, it should be taken from the marinade and placed in the refrigerator in a covered container.</p>	<p>1. Place prepared ingredients in the fridge in less than 1 hour. Cover ingredients first.</p> <p>2. When it's time to serve, reheat meat until its steaming hot or until internal temperature reaches 75°C. You could use a microwave or grill to reheat.</p>	<p>1. Wash your hands with hot water and soap for 40 seconds and dry with paper towel.</p> <p>2. Take the pork and put it in a glass or plastic dish that has a tight cover available.</p> <p>3. Let the pork cool just for a few minutes.</p> <p>4. Put the lid on the container and place it in the fridge which is set at 4°C.</p> <p>5. When your friend arrives, take the pork out of the fridge and reheat it until it is steaming hot.</p>	<p>1. I will inform everyone to wait till other friend arrives before I start cooking.</p> <p>2. I will take the portion out for my late friend and store the steak in a container with a lid or cling wrap and place the container in the coolest part of the fridge till my friend arrives.</p> <p>3. Start cooking and then leave the cooked steak (late friend's portion) cool then store the steak in a container, and put into fridge. When my friend arrives, reheat the steak until proper temperature (as high as possible).</p>
Maximum point is 5	2.5 points	5 points	5 points	4 points

Table 34-4: Week 3 results for Question 2 for control group

Question 2: Clearly describe all the steps you would take to preserve the meal till your friend arrives and is ready to eat.				
Recommended Answer	DCW's response	DCT's response	DCV's response	DCH's response
<p>1. Cool the meat for less than 1 hour. Cover and store the food in the fridge till the friend arrives.</p> <p>2. Reheat till it is steaming hot before serving to friend.</p>	<p>1. Remove the portion of Pork Steak and veggies from the remaining portions. Place into a storage container and allow it to cool briefly (up to 1 hour but no longer, however, given the size 15-30 minutes should be sufficient.</p> <p>2. Cover with a lid or plastic wrap and place in the refrigerator above raw meats to avoid contamination from dripping.</p> <p>3. When the friend arrives remove from the fridge and reheat to steaming before serving.</p>	<p>1. Once the meat is done, I will cover it with foil and put in an airtight box until they have cooled and then put it in the fridge.</p> <p>2. When the friend comes, I will take it from the fridge and warm it in a microwave oven until it is steaming hot and then serve.</p>	<p>1. Divide the components of the meal and place onto different plates or containers. Place them in the fridge immediately.</p> <p>2. Reheat all (apart from Salad) meal components until they are steaming hot once the friend arrives.</p>	<p>1. Separate the meat and the potatoes. Allow to cool on the bench for no more than 1 hour and then seal and place in the fridge on a higher shelf than any raw meat. If this is not possible then make sure the food is stored in securely sealed airtight containers so that it cannot be dripped on whilst in the fridge.</p> <p>2. When the friend arrives, the meal should be reheated until it is steaming hot.</p>
Maximum point is 5	5 points	4 points	5 points	5 points

Tables 34-5 and 34-6 reveal the results of the open-ended questions for question 3 for the experimental group and control group respectively.

Table 34-5: Week 3 results for Question 3 for experimental group

Question 3: Clearly describe all the steps you would take to store the leftover lunch and the raw chicken in your fridge while ensuring the safety of the leftover.				
Recommended Answer	ACJ's response	ACC's response	ACH's response	ACM's response
<p>1. <i>The leftover lunch must be covered</i></p> <p>2. <i>The leftover lunch must be placed on a shelf above the chicken</i></p> <p>3. <i>The chicken must be placed in the coldest part of the refrigerator</i></p> <p>4. <i>The chicken should be placed in a plastic container and covered</i></p>	<p>1. The leftover should be placed in a sealed container in the refrigerator on a shelf above any raw meat..</p> <p>2. The chicken should be placed in a sealed container or wrapped in a leak proof cling wrapper on a plate and stored below any other food stored in the fridge in case of any inadvertent leakage from the chicken.</p>	<p>1. For leftovers, wrap or cover with cling wrap or place in a sealed container. Place on a higher shelf in refrigerator in less than one hour after they were prepared.</p> <p>2. Wash chicken under cold water, dry with paper towel, seal in plastic bag as soon as you get home. Do not leave on bench for extended time. Place in the fridge in either the coldest part of the fridge preferably on shelf below cooked leftovers.</p>	<p>1. Wash hands with warm water and soap for 40 seconds and dry with paper towel.</p> <p>2. Place the chicken in the coldest part of the fridge.</p> <p>3. Repeat step 1.</p> <p>4. Ensure that leftovers are placed in a covered glass or plastic container in the fridge.</p> <p>5. Ensure chicken is stored below the leftovers in the fridge.</p> <p>6. The fridge must be 4°C or less.</p>	<p>1. Place leftover in a container with lid or cling wrap and store them on the top shelf of my fridge.</p> <p>2. Clean used lunch dishes with warm water and dishwasher.</p> <p>3. Wash my hands with warm water and soap and rub hands for at least 30 seconds.</p> <p>4. Place chicken in a container and place it in the coolest part of the fridge for next 5 hours.</p> <p>5. Wash the board with hot water and soap and dry it with paper towel.</p> <p>6. Wash my hands (Repeat step 3) and clean kitchen benchtop.</p>
Maximum point is 5	4 points	5 points	5 points	4 points

Table 34-6: Week 3 results for Question 3 for control group

Question 3: Clearly describe all the steps you would take to store the leftover lunch and the raw chicken in your fridge while ensuring the safety of the leftover.				
Recommended Answer	DCW's response	DCT's response	DCV's response	DCH's response
<p>1. <i>The leftover lunch must be covered</i></p> <p>2. <i>The leftover lunch must be placed on a shelf above the chicken</i></p> <p>3. <i>The chicken must be placed in the coldest part of the refrigerator</i></p> <p>4. <i>The chicken should be placed in a plastic container and covered</i></p>	<p>1. Allow the sandwiches to cool for approximately 15 minutes. Place into a container or on a plate and cover with a lid or plastic wrap. Place this item at the top of the fridge above raw meat.</p> <p>2. Place the chicken into a bag or container and seal. Place this container on the bottom shelf of the fridge away from and underneath other food.</p>	<p>1. Wash hands and cut the meat in appropriate slices and then put them into the air-tight box and put them in the fridge.</p> <p>2. Avoid putting them above the well done meat.</p>	<p>1. Wrap or place leftover in a container. Place above the raw meat in the fridge.</p> <p>2. Seal chicken breast or container and place below the lunch leftover in the fridge.</p> <p>3. There is a place in the fridge that is coldest and best suited for storing meat. I am not quite sure but it might be at the back and on a lower shelf in the fridge.</p>	<p>1. Separate the chicken into small portions, seal in airtight bags or containers and place in the coldest part of the fridge.</p> <p>2. Wash your hands thoroughly with soap and hot water rubbing for at least 30 seconds.</p> <p>3. Separate the leftovers from lunch into small portions and seal in airtight containers. Store these above the raw meat if possible. If not then ensure they are covered to avoid being dripped on.</p>
Maximum point is 5	4 points	2.5 points	5 points	4.5 points

Tables 34-7 and 34-8 reveal the results of the open-ended questions for question 4 for the experimental group and control group respectively.

Table 34-7: Week 3 results for Question 4 for experimental group

Question 4: Clearly describe all the steps you would take to ensure your hands are clean before you roll the wraps.				
Recommended Answer	ACJ's response	ACC's response	ACH's response	ACM's response
1. Wash hands in soap and hot water 2. Wash hands for up to 30 seconds 3. Dry hands with paper towel	1. Wash hands in hot soapy water and dry hands them using paper towels. 2. Empty sink containing soapy hot water prior to drying hands.	1. Wash hands in hot soapy water for at least 30 seconds. 2. Make sure all surfaces are thoroughly washed. 3. Dry with paper towel.	1. Wash hands with soap and hot water for at least 40 seconds. 2. Dry hands thoroughly with paper towel.	1. Wash my hands with warm water and soap. 2. Make sure I rub my hands for at least 30 seconds. 3. Dry my hands with paper towel.
Maximum point is 5	4 points	5 points	4 points	5 points

Table 34-8: Week 3 results for Question 4 for control group

Question 4: Clearly describe all the steps you would take to ensure your hands are clean before you roll the wraps.				
Recommended Answer	DCW's response	DCT's response	DCV's response	DCH's response
1. Wash hands in soap and hot water 2. Wash hands for up to 30 seconds 3. Dry hands with paper towel	1. Wet your hands under running warm water. Apply soap to hands and rub for at least 30 seconds getting underneath fingernails, in between fingers, thumb and back of the hand. 2. Rinse thoroughly and dry with paper towel.	1. Wash hands with warm water and soap for at least 30 seconds and rinse it. 2. Dry hands with towel and continue to wrap the meat.	1. Wash hands for at least 30 seconds with warm soapy water. 2. Dry hands with paper towel.	1. Remove any rings and watches. Rinse hands under the tap to remove dirt. Apply soap to hands and wrists for at least 30 seconds. 2. Wash off the soap using hot water from the tap. 3. Dry hands on paper towel.

<i>Maximum point is 5</i>	5 points	3.5 points	5 points	5 points
--------------------------------------	-----------------	-------------------	-----------------	-----------------

35 APPENDIX Z – DETAILS OF FIELD EXPERIMENT RESULTS IN WEEK 4

Tables 35-1 and 35-2 reveal the results of the open-ended questions for question 1 for the experimental group and control group respectively.

Table 35-1: Week 4 results for Question 1 for experimental group

Question 1: Critically examine Table A. You want to use the knife and chopping board to cut the snow peas, tomatoes and the onions. Clearly describe all the steps you will take to ensure you avoid cross contamination.				
<ul style="list-style-type: none"> • Please provide a minimum of 4 steps. • Please discuss only one method, based on the materials available to you in the context provided. 				
Recommended Answer	ACJ's response	ACC's response	ACH's response	ACM's response
1. I will put the meat in a separate container. 2. I will thoroughly wash the chopping board and knife with soap and hot water and dry them. 3. I will wash my hands thoroughly with soap and hot water for more than 30 seconds after handling the meat. 4. Then I will cut the vegetables and put them in a separate	1. Remove chopped meat from board and place in a bowl. 2. Turn board over to present a new surface. 3. Cut ends of tomatoes to clean chopping knife. 4. Cut snow peas first, tomatoes next and onions last as they have strongest odours. 5. Place chopped vegetables in a clean	1. Place chopped meat in stainless steel bowl. 2. Wash chopping board and knife in hot soapy water. 3. Air dry or wipe with clean towel. 4. Wash hands – 30 seconds with hot soapy water and dry thoroughly. 5. Chop vegetables and place in clean stainless bowl. 6. Wash hands and	1. Wash hands with soap and hot water for at least 40 seconds. 2. Dry hands with paper towel. 3. Put the pieces of meat in the large stainless steel bowl. 4. Wash the chopping board and the knife in hot soapy water and let them air dry. 5. Wash hands with soap and hot water for at least 40 seconds and	1. Place meat in a bowl and store it safely in the fridge. 2. Wash knife and chopping board with hot water and soap and dry them with paper towel. 3. Cut snow peas first and then tomatoes. 4. Wash knife and chopping board with hot water and soap and dry them with paper towel (wash tomato juice from cutting) 5. Cut onions. 6. Repeat step 2.

<i>container.</i>	bowl.	knife and board with hot soapy water and dry.	dry on paper towel. 6. Chop each of the vegetables and place in the small stainless steel bowl.	
Maximum point is 5	2 points	5 points	5 points	3.5 points

Table 35-2: Week 4 results for Question 1 for control group

Question 1: Critically examine Table A. You want to use the knife and chopping board to cut the snow peas, tomatoes and the onions. Clearly describe all the steps you will take to ensure you avoid cross contamination.

- Please provide a minimum of 4 steps.
- Please discuss only one method, based on the materials available to you in the context provided.

Recommended Answer	DCW's response	DCT's response	DCV's response	DCH's response
<p>1. <i>I will put the meat in a separate container.</i></p> <p>2. <i>I will thoroughly wash the chopping board and knife with soap and hot water and dry them.</i></p> <p>3. <i>I will wash my hands thoroughly with soap and hot water for</i></p>	<p>1. Transfer the raw meat into the smaller of the two bowls.</p> <p>2. Run a sink of hot soapy water.</p> <p>3. Thoroughly wash the chopping board and knife.</p> <p>4. Rinse both in hot running water.</p> <p>5. Allow to stand and dry (use paper towel to dry if</p>	<p>1. After cutting the meat, put it in a bowl and wash the board and knife with hot soapy water.</p> <p>2. Wash hand for at least 30s with hot soapy water and dry hands with tea towel.</p> <p>3. Wash snow peas, tomatoes</p>	<p>1. Place cut meat in bowl, cover with cling wrap, and place in fridge for later use.</p> <p>2. Wash knife and chopping board with warm soapy water and dry (air dry would be best). If you don't have time to air dry, use a different</p>	<p>1. Place meat in the metal bowl.</p> <p>2. Wash knife and chopping board with hot soapy water.</p> <p>3. Wash hands in hot soapy water, scrubbing for at least 10 seconds.</p> <p>4. Dry everything with paper towel and chop.</p> <p>5. If step 2 is not possible, use a fresh chopping board and knife and wear gloves.</p>

<p>more than 30 seconds after handling the meat.</p> <p>4. Then I will cut the vegetables and put them in a separate container.</p>	<p>necessary).</p> <p>6. Place the knife and chopping board back onto the bench.</p> <p>7. Now that the knife and chopping board have been cleaned, it can be used for the fresh produce.</p>	<p>and onions and then peel and cut them on the board.</p> <p>4. After cutting them, put them into the bowl and wash cutting board and knife with hot soapy water and wash hands.</p>	<p>knife and chopping board.</p> <p>3. Continue with cutting the snow peas (least moist and odorous) to place in bowl.</p> <p>4. Chop tomatoes and place in another bowl, chop onions last.</p>	<p>Step 4 should be followed if possible.</p> <p>6. As the onion would be cooked, it should be chopped last. If this is not possible repeat steps 2 & 3 before chopping the other veggies.</p>
Maximum point is 5	3.5 points	4.5 points	3.5 points	5 points

Tables 35-3 and 35-4 reveal the results of the open-ended questions for question 2 for the experimental group and control group respectively.

Table 35-3: Week 4 results for Question 2 for experimental group

<p>Question 2: Critically examine Table B and read through the information provided about the chicken.</p> <p>a. Is it safe to eat the chicken?</p> <p>b. Why? (Please provide a minimum of 2 reasons for your answer)</p>				
Recommended Answer	ACJ's response	ACC's response	ACH's response	ACM's response
<p>1. No</p> <p>2. The steak has been left on the benchtop for more than 1 hour which makes it unsafe</p> <p>3. I used a</p>	<p>1. No.</p> <p>2. The chicken has been left uncovered for more than 2 hours. It should be placed in a covered</p>	<p>1. No.</p> <p>2. Chicken was placed uncovered on bench – exposed.</p> <p>3. Chicken was placed on bench 130 minutes ago. It</p>	<p>1. No.</p> <p>2. It has been left out on the bench for longer than 30 minutes which is longer than the recommender safe time for cooked meat to be left out after cooking. It should</p>	<p>1. Yes (however, it should be reheated through).</p> <p>2. Cooked to the highest safety standards and is well</p>

<i>thermometer to check the current internal temperature and it is within the danger zone (4°C to 60°C)</i>	<p>container in a fridge.</p> <p>3. The internal temperature is only 40.2°C, which is likely to encourage bacterial growth.</p>	<p>needed to be placed in fridge maximum of 1 hour after cooking.</p> <p>4. Internal temperature of chicken would be between 4°C and 70°C. Bacteria would flourish. On checking, temperature was 41.3°C</p>	<p>have been put in the fridge within 30 minutes after being fully cooked.</p> <p>3. The internal temperature of the chicken is between 28 and 30 degrees. This is a temperature at which bacteria thrives.</p> <p>4. The chicken has not been covered.</p>	<p>done.</p> <p>3. Left on the bench for less than 3 hours.</p>
<i>Maximum point is 5</i>	5 points	5 points	5 points	0 points

Table 35-4: Week 4 results for Question 2 for control group

Question 2: Critically examine Table B and read through the information provided about the chicken.

- Is it safe to eat the chicken?**
- Why? (Please provide a minimum of 2 reasons for your answer)**

Recommended Answer	DCW's response	DCT's response	DCV's response	DCH's response
<p>1. No</p> <p>2. The steak has been left on the benchtop for more than 1 hour which makes it unsafe</p> <p>3. I used a thermometer to check the current internal temperature</p>	<p>1. No.</p> <p>2. Cooling on the bench should not occur for longer than 1 hour, so has sat for longer than is recommended by 70 minutes.</p> <p>3. The internal temperature is at 35.5°C. This is well and truly inside the</p>	<p>1. No.</p> <p>2. The bacteria will grow from 4°C - 60°C. It is apparent that the chicken has been in a dangerous situation for 130 minutes. It should be put into the fridge before eating.</p>	<p>1. No.</p> <p>2. If food is cooked to be served at a later time, it needs to be refrigerated immediately and reheated to steaming hot before serving it at a later time.</p> <p>3. Don't know. Sorry. Use gloves to insert food thermometer into chicken to</p>	<p>1. No</p> <p>2. Food should only be left for no more than one hour before refrigerating. This meat has been on the bench for over 2 hours.</p> <p>3. The chicken temperatur</p>

<i>and it is within the danger zone (4°C to 60°C)</i>	<p>danger zone.</p> <p>4. The chicken is uncovered and risks possible cross contamination.</p> <p>5. For bacteria that may have made it into the chicken during cooling could now be at a dangerous level.</p>	3. The standard of cooking is not based on time or colour but on the temperature of the centre, so must read the thermometer to see if it is well done or not.	check the core temperature. There probably is a relation between core temperature and safe consumption.	e is only 40.3°C. It should be at least 75°C.
Maximum point is 5	5 points	4 points	2 points	5 points

Tables 35-5 and 35-6 reveal the results of the open-ended questions for question 3 for the experimental group and control group respectively.

Table 35-5: Week 4 results for Question 3 for experimental group

Question 3: Critically examine Table C.				
<p>a. You have finished cutting the pork into smaller pieces. You have washed your hands with warm soapy water for 30 seconds and you have perfectly dried your hands with the kitchen towel on the table. Have you cleaned your hands in accordance with best practice guidelines?</p> <p>b. Please give a significant reason to justify your answer in “a” above.</p>				
Recommended Answer	ACJ's response	ACC's response	ACH's response	ACM's response
1. No	1. No.	1. No.	1. No.	1. No.
2. The kitchen towel has been soiled with the juice from the pork.	2. The kitchen towel is contaminated with unknown fluid. Paper towels would be the best for	2. The kitchen towel is contaminated with blood from the pork and may be the knife or chopping	2. Handwashing should have been for 40 seconds. 3. The kitchen towel has some	2. The warm soapy water and 30 seconds part is all good. However it

<i>Therefore, it has been contaminated with bacteria. Using the towel to dry my hands returns the bacteria I initially washed away, thus making the washing process counter-productive.</i>	drying hands according to best practice guidelines.	board has been wiped with the towel. The towel used to dry hands needs to be clean and not contaminated. Paper towel or a clean towel is required.	form of liquid from the pork (or other meat) on it, and you wiped your hands on it. You may have got bacteria on your hands. 4. Tea towel should be put in the wash and not used for any purpose.	is clear that raw pork juice is on the kitchen towel. 3. After washing hands with warm soapy water for 30 seconds, we should use clean paper towel to dry hands.
<i>Maximum point is 5</i>	5 points	5 points	5 points	5 points

Table 35-6: Week 4 results for Question 3 for control group

Question 3: Critically examine Table C.

- a. **You have finished cutting the pork into smaller pieces. You have washed your hands with warm soapy water for 30 seconds and you have perfectly dried your hands with the kitchen towel on the table. Have you cleaned your hands in accordance with best practice guidelines?**
- b. **Please give a significant reason to justify your answer in “a” above.**

Recommended Answer	DCW's response	DCT's response	DCV's response	DCH's response
1. No	1. No.	1. Yes.	1. No.	1. No.
2. The kitchen towel has been soiled with the juice from the pork.	2. For best practice guidelines, you would have perfectly dried your hands using	2. Washing hands thoroughly can effectively avoid	2. The kitchen towel is soiled with meat juices (blood). By using it today on my hands, I make	2. The towel is covered in meat juices which means it is harbouring as much bacteria as the meat.

<i>Therefore, it has been contaminated with bacteria. Using the towel to dry my hands returns the bacteria I initially washed away, thus making the washing process counter-productive.</i>	paper towel. The tea towel is unclean, it is covered in the raw pork juice which will more than likely contain bacteria. That bacteria is now on your hands and you will transfer it to everything you now touch.	cross contamination.	the washing of my hands with warm soapy water redundant as I will contaminate my hands with meat juices. Best practice would be to thoroughly dry my hands with a fresh paper towel.	Additionally, best practice states that hands should be dried with paper towel as kitchen towels are difficult to sterilise so they by default harbour bacteria anyway. Also the water used for washing should be hot and not merely warm.
<i>Maximum point is 5</i>	5 points	0 points	5 points	5 points

Tables 35-7 and 35-8 below reveal the results of the open-ended questions for question 4 for the experimental group and control group respectively.

Table 35-7: Week 4 results for Question 4 for experimental group

Question 4: Critically examine the fridge at station D a. Examine the fridge, the container labelled “uncooked premium Tasmanian salmon” and the container labelled “garden salad”. Is the storage arrangement of those 2 items in accordance with best practice? b. Please give a minimum of 4 reasons to justify your answer in “a” above. <i>Please note that this fridge is usually used in a commercial setting, such as a professional chef’s kitchen. Therefore, it does not have the basic configuration of a domestic fridge. However, the most important information is that the internal temperature in the fridge is equal for all parts in the fridge.</i>				
Recommended Answer	ACJ’s response	ACC’s response	ACH’s response	ACM’s response
1. Yes	1. Yes	1. Both items are in sealed containers. No	1. Yes.	1. Salmon container should be
2. The salad	2. Salad is		2. The two	

<p><i>is covered.</i></p> <p>3. <i>The salad is placed on a shelf above the fish</i></p> <p>4. <i>The fish is in the refrigerator with a temperature below 4°C</i></p> <p>5. <i>The fish is in a sealed plastic container.</i></p>	<p>stored on shelf above uncooked salmon – reducing cross contamination</p> <p>3. Containers used are securely sealed.</p> <p>4. Fridge temperature stabilizes to around 1.0 – 3.0°C.</p> <p>5. Containers are clearly labelled to identify food and prevent cross contamination.</p>	<p>chance of juice dripping onto other foods.</p> <p>2. The raw meat is placed below the salad – cannot cross contaminate food which will not be cooked.</p> <p>3. Sealed containers prevent flavours or odours from cross contaminating other foods.</p> <p>4. Meat is in the coldest area of fridge and fridge is between 3 and 5°C.</p> <p>5. They are on separate shelves.</p>	<p>items are stored in separate containers and on different shelves.</p> <p>3. Both containers are sealed.</p> <p>4. The garden salad is stored above the salmon.</p> <p>5. The temperature of the fridge remains below 30°C.</p> <p>6. Both containers have been labelled so you know what is in them and find the salmon has not been cooked.</p>	<p>wrapped with cling wrap</p> <p>2. Temperature should be 0°C. Currently 2.5°C.</p> <p>3. Salmon container may be placed in the coolest part of the fridge (As we are using commercial fridge, so it looks ok).</p> <p>4. Salmon container can be placed at the bottom of the fridge.</p>
<i>Maximum point is 5</i>	4 points	5 points	4 points	2 points

Table 35-8: Week 4 results for Question 4 for control group

Question 4: Critically examine the fridge at station D

- Examine the fridge, the container labelled “uncooked premium Tasmanian salmon” and the container labelled “garden salad”. Is the storage arrangement of those 2 items in accordance with best practice?
- Please give a minimum of 4 reasons to justify your answer in “a” above.

Please note that this fridge is usually used in a commercial setting, such as a professional chef’s kitchen. Therefore, it does not have the basic configuration of a domestic fridge. However, the most important information is that the

<i>internal temperature in the fridge is equal for all parts in the fridge.</i>				
Recommended Answer	DCW's response	DCT's response	DCV's response	DCH's response
1. Yes 2. The salad is covered. 3. The salad is placed on a shelf above the fish 4. The fish is in the refrigerator with a temperature below 4°C 5. The fish is in a sealed plastic container.	1. Yes 2. Both containers are in plastic food grade seal containers 3. The garden salad is located above the raw fish. 4. The odour of the fish is being contained within the sealed container so as not to affect other foods. 5. The juices are contained within the sealed containers. 6. The salad cannot be contaminated.	1. Yes 2. They are in the air-tight container. 3. The temperature of the fridge is right. 4. Putting them separated in the fridge. 5. Uncooked food is put under the cooked food which can avoid cross contamination.	1. Yes. 2. Both items are sealed and can't be penetrated by other odours that also might impact on the task (e.g. left open cheese) 3. It's best to store raw food (meat or fish in particular) below cooked food and fresh food to avoid cross contamination due to dripping (meat) juices.	1. No 2. Raw meat should be stored lower than uncooked food. 3. Food should be stored in small portions and in sealed plastic containers. 4. Food should be labelled with an expiry date. The salmon does not meet criteria 2 and 4 so it is not properly stored. Best practice is to salad in a crisper under a solid lid at the bottom of the fridge to avoid trapping moisture and being dripped on.
Maximum point is 5	4 points	4 points	3 points	0 points

36 APPENDIX AA – DETAILS OF THE DATA ANALYSIS

This section presents the data analysis methods employed within this research. As discussed in this chapter, the research data were both qualitative and quantitative in nature (see section 3.5) and they required a subjective ontological and a pragmatic epistemological philosophy (see sections 3.2.1 and 3.2.2). The quantitative data was analysed using both descriptive and inferential statistics while the qualitative data was analysed with an inductive thematic approach. In this section the data analysis approach is presented with examples from each research phase.

36.1.1 Theory of Analysis – Quantitative

36.1.1.1 Descriptive Analysis

According to Knupfer and McLellan (2001) descriptive statistics employ data collection and analysis methods that generate reports in relation to the measures of central tendency, variation, and correlation. The mixture of its characteristic summary and correlational statistics, with its focus on specific types of research questions, methods, and outcomes differentiates descriptive research from other research types (Knupfer and McLellan, 2001). Description occurs after creative exploration. The aim of descriptions is to organise the findings such that they can be fit into explanations, (Kratwohl, 1993). Some of the common data collection methods applied to descriptive research includes the use of questionnaires, interviews, observations, and portfolios.

Descriptive analysis can be done at a simple level and at a complicated level. An example of a simple descriptive analysis shows how the total sample has distributed itself on the response alternatives for a single questionnaire item which is called marginal tabulation (Knupfer and McLellan, 2001). Descriptive statistics are different from inferential statistics in that descriptive statistics describes what the data shows while inferential statistics helps to provide conclusions that extend beyond the immediate data alone (Trochim, 2006). Within descriptive statistics, univariate analysis of data and simple graphical analysis helps simplify large amounts of data (Trochim, 2006). Univariate analysis is the examination of a variable at a time across cases. The characteristics of a single variable are the frequency distribution, the central tendency (mean, mode and median) and the dispersion (standard deviation).

In this study, some of the data collected through the use of survey in the Advanced Stage, Phase One – Investigating Knowledge Gaps – Consumer Perspective, was analysed through the descriptive statistics. Some of the data collected in Phase Two – Design and Development of the Safe Food Management App and some of the data collected in Phase 3 – Implementing and Evaluating the Safe Food Management App was analysed through descriptive statistics. After the data collection, the data was exported to Microsoft Excel 2010 for initial formatting and then imported into IBM SPSS software version 22.0 for better analysis.

36.1.1.2 Inferential Analysis

Inferential statistics involves utilising a set of procedures to make inferences, predictions or decisions about the characteristics of a population based on the information contained in the sample (Mendenhall et al., 1989). According to Mendenhall et al. (1989), statistical problems basically involve the following steps;

- Identifying the question and the population of data associated with the question
- Designing the sampling procedure
- Collecting and analysing the data
- Determining the procedure for making inference concerning the population based on the sample information
- Providing a measure of reliability for the inference

With inferential statistics, conclusions which extend beyond the immediate data alone can be reached. This analytical approach is utilised when it is imperative to make generalisations from a sample to a population. In this study, a variety of statistical analyses were conducted to identify patterns in the data and help us answer our research questions; this was the scaled simple count method for the best-worst scores.

As revealed by Marley and Louviere (2005), interpreting the best-worst scale is relatively easy using a scaled simple count method. They show that the simple difference in best-worst scores (taking the number of times an item is considered “best” and subtracting the number of times it is considered “worst”) is a close approximation of the true scale values. The scale values obtained from Multinomial Logit analyses have been validated by Auger et al. (2007), Finn and Louviere (1992). These properties allow for a quick and simple examination of the relative value of an issue by simply scaling the

number of times an issue is considered “best” against the number of times it is considered “worst.” Following this approach, the researcher calculated the best-worst score for each of the constructs by subtracting the number of times an attribute was selected as “least important” from the number of times that same issue was selected as “most important.” The results of these calculations are individual-level scales for each of the attributes that are easily comparable across the entire sample. For example, a value of +3 could be obtained if a respondent selected an issue as most important four times and selected the same issue once as least important.

36.1.2 Theory of Analysis – Qualitative

36.1.2.1 Thematic Analysis

Thematic analysis is a process that is used to encode qualitative information in order to uncover the themes that are significant in a text at different levels (Attride-Stirling, 2001). A theme is a pattern that has been discovered in the information, which describes and structures possible observations, at least but has the potential to interpret aspects of a phenomenon (Boyatzis, 1998). Thematic analysis is beyond counting explicit words or phrases. It focuses on identifying and describing both the embedded and obvious ideas within the data, that is, themes (Guest et al., 2012). Codes are then developed to represent the identified themes which could also be applied or linked to raw data for later analysis.

According to Braun and Clarke (2006) analytic methods that also describe patterns across qualitative data such as grounded theory (GT) and Interpretative Phenomenological Analysis (IPA) are different from thematic analysis. Though IPA and grounded theory seek patterns in data, they are theoretically bounded. IPA is associated with a phenomenological epistemology (Smith and Osborn, 2003) which is about getting a detailed understanding of the daily experience of people in reality in order to provide insight into the phenomenon being investigated (McLeod, 2003). This method places a high priority on experience (Holloway and Todres, 2003).

Grounded theory (GT) is defined as “a general methodology of analysis linked with data collection that uses a systematically applied set of methods to generate an inductive theory about a substantive area” (Glasser, 1992). GT analysis aims to generate a plausible and useful theory of the phenomenon that is grounded in the data (McLeod,

2003). However, there are different versions of GT (Charmaz, 2006). It has been argued that GT has been increasingly used in a less rigorous manner which does not appear to be fully immersed in the theoretical commitments of a “full-fat” grounded theory as GT directs analysis towards theory development (Holloway and Todres, 2003, Braun and Clarke, 2006). Consistent with this argument, Braun and Clarke (2006) has argued that it is more reasonable to be upfront about the use of thematic analysis which does not associate one with the implicit theoretical commitments of grounded theory.

In contrast to IPA and GT, thematic analysis is not associated with any pre-existing theoretical framework and can be used within any framework such as a realist or relativist framework (Braun and Clarke, 2006). However, the theoretical framework underpinning the research, which has an effect on the thematic analysis being done, has to be clearly stated as it has been done in section 3.2.1. The rigour in the method of analysis that has been chosen lies in the development of a ‘systematic method whose assumptions are congruent with the way one conceptualizes the subject matter’ (Reicher and Taylor, 2005) p. 549.

According to Braun and Clarke (2006), the basic process of conducting thematic analysis involves, familiarization with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes and producing the report. Thematic analysis is very useful because it is flexible; it can generate unanticipated insights and it can offer thick description of a data set among other reasons. The information gathering capability of thematic analysis and the inductive process makes it a valid analytical approach to this research. In this study, thematic analysis was applied at a latent level, in order to understand the underlying meaning of the data. According to Braun and Clarke (2006), it is this transition from the semantic level to the latent level that allows patterns to be seen in the data while providing meanings and revealing how the patterns are formed.

This data analysis approach in research incorporates Strauss and Corbin’s (1994) coding paradigm of open and axial codes before developing the themes. The open and axial codes in this paradigm are commonly connected to grounded theory. Grounded theory is now commonly used within the information systems discipline (Urquhart and Fernandez, 2006). Justified by Glaser’s (1999) support of mixing grounded theory with

other methods, based on relevant principles related to the researcher's domain; this study utilised grounded theory principles in order to begin the coding process. Therefore, the data analysis was conducted at three conceptual coding levels: open, axial and themes. In order to address the research aims, the open codes developed in this research were not suitable as they were not sufficiently abstracted. At the level of the axial coding, it was realised that the codes took the data past just a listing of concepts (Corbin and Strauss, 1990). The impact of the principles of grounded theory which was incorporated was felt as it assisted in achieving the required level of abstraction. At the final level of analysis, the resulting themes had progressed past the level of data description to the level of initial stages of data interpretation (Braun and Clarke, 2006). Through this process, the thematic analysis in this research illustrates how axial codes can be correlated into final themes, rather than correlation between axial codes themselves.

According to Boyatzis (1998), two main benefits of incorporating thematic analysis are as follows;

- It allows the researcher to capture insights that may not be visible to others, and code it such that it can become visible to them and provide an interpretation of the captured insight.
- It provides a way in which the researcher can make sense out of seemingly unrelated material.

As these benefits align with the aim and objectives of this investigation, thematic analysis has helped in creating an understanding of the research area that covers a range of multiple perspectives. This was done through the generation of codes that allowed the unseen to be captured and the unrelated to become related. In this study, the inductive coding approach was used at a sentence level which allowed the essential elements that are associated with research phenomena to be captured. This approach was used to analyse data generated from the Preliminary stage, Phase One: Investigating Knowledge Gaps – Firm Perspective and the data generated from the card sorting process conducted in Phase Two: Design and Development of the Safe Food Management App.

36.1.3 Analytical Approach

In this sub-section, the research method of analysis is presented. The process of analysis is presented as well as the development of the summary codes. Thereafter, the coding process for all the three stages of the research is presented. Figure 3-5 illustrates the process of analysis used throughout the stages of the research.

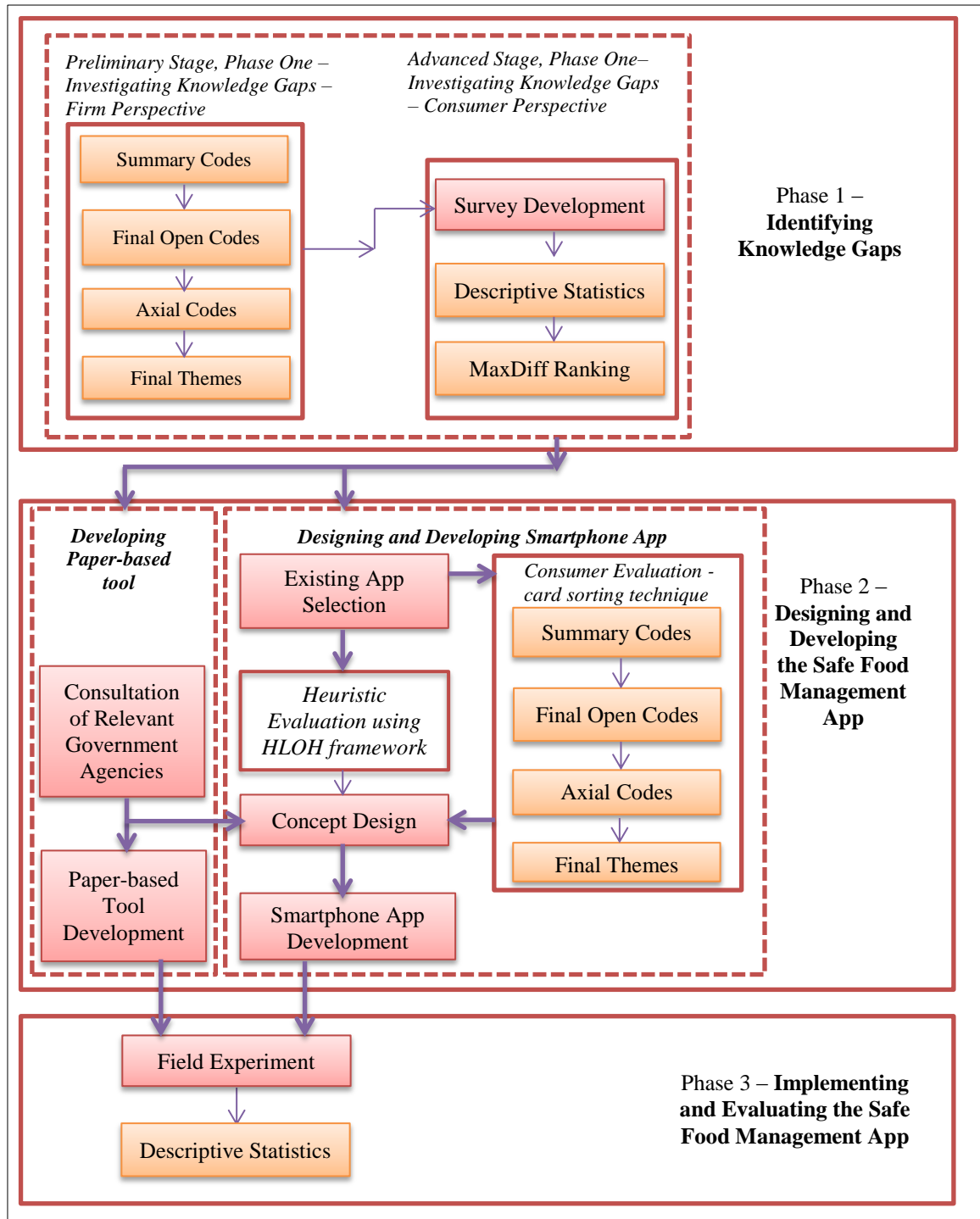


Figure 36-1: Research Analysis Process

36.1.3.1 Summary Codes

In order to ensure a good connection between the resulting analysis and the raw data, the summary coding process was used. Based on the aims of the research, Urquhart (2000)

has argued that this stage can have one or more iterations. The summary codes are strongly linked to the data with a description of each component at the sentence level through the code name (Urquhart, 2000). The summary codes were derived first before moving on to open coding. The interview transcript was printed in Microsoft Word and reviewed so as to make the researcher familiar with the data. The electronic copy of the Microsoft Word transcript was converted to a worksheet in Microsoft Excel. Coding was then completed at a sentence level.

The summary codes of the interview in Phase One, Stage One was the first stage of removing the data from the interview transcripts. A total of 467 unique summary codes were developed in this Phase. The summary codes were reviewed in order to ensure each of them reflected only the content of the interview transcript. First, this was done to ensure that the summary codes reflected the data; thus emphasising the inductive approach utilised in the thematic data analysis (Glaser, 1992). Second, it was done to ensure that the codes had sufficient meaning which enabled them to be separated from the raw data.

The original summary codes represented short sentences. The analysis of the interview transcripts into the summary codes underwent several iterations to develop complete summary codes. As detailed in Figure 3-6 the summary codes were referenced to the interview transcripts through the line number while highlighting the relevant phrases.

L N No	
80	<i>Cheese consistency is key</i> it could be absolutely great but if it isn't consistent, you will never buy it again. So the consistency
81	<i>Cheese consistency is key</i> was the first thing to get right. Then we could say what do we want to produce, we know how to get
82	<i>Seasonal variation sometimes occur</i> the consistency, there is still a little bit of seasonal variation but it's like this, I always say, no matter
83	<i>Philosophy is never to exceed threshold</i> what, you draw two lines and you can play however you want within those two lines, as soon as you
84	<i>Exceeding threshold causes customer loss</i> start exceeding it, this is where you start losing customers. That diagram is one of my big
85	<i>Philosophy is never to exceed threshold</i> philosophies. I love that diagram. That diagram to me just makes so much sense. You play in that
86	<i>If threshold is exceeded, circumvent it in-house</i> spot and never go outside. As soon as you do, though this still happens at times but we circumvent it
87	<i>Use threshold limit for quality control</i> in here and that's where that doesn't go out. That's where that is the quality control...

Figure 36-2: Interview Transcript with Summary Code Identified

Table 3-4 provides an example of summary codes undergoing iterations before finalizing the final codes.

Table 36-1: Summary Codes with Several Iterations

Summary Code (First Iteration)	Summary Code (Second Iteration)
Conduct press releases on new products personally	Conduct personal press release on NP
Make use of good pictures for press releases	Use good pictures for press releases
Uptake on personal press releases are good	Good uptake on personal press release
Cheeses rely on consumer taste & not age	Chs rely on consumer taste
Consumer classification by disposable income	Consumer classification by disposable income
High competition for the mainstream	High competition for mainstream Chs
No competition for the high end (uncommon offering)	No competition for high end Chs
The bulk offering is for all & it's very cheap	Bulk offering is for all
	Bulk offering is cheap
The importers are the major competitors & the real threat	Importers are major competitors
	Importers are real threats
Consumer interest in buying local is an advantage over importers	Interest in buying local an edge over importers

Table 3-5 provides an example of the pseudo-codes and meanings, which are utilised in the coding process.

Table 36-2: Pseudo-codes and Meanings used in the Coding Process

Pseudocode	Meaning
ACD	Automated Critical Documentation
BM	Bufallo Mozzarella
Chs	Cheeses
CRM	Customer relationship management
Env	Environmental
FSS	Food safety systems
Govt.	Government authority
Info	Information
IP	Intellectual Property
ISD	Inter-state distributors
IT	Information technology
MPF	Marinated Persian Feta
NP	New product
NTSP	Non-technology savvy population

36.1.3.2 Open Coding

In order to move beyond the descriptive nature of the summary codes and to progress to an analytical label, the open codes had to undergo a number of iterations (Dey, 2003, Urquhart, 2000). According to Corbin and Strauss (1990), the process of open coding is helpful in questioning the researcher's assumptions about the data, thus allowing the data to entirely represent the views of the participants. Therefore, as the coding process progresses from the raw data, the codes become useful in slightly abstracting the data.

After the completion of the open codes, they were placed into a different Microsoft Excel worksheet. For the Preliminary stage, Phase one of the study, a total of 186 open codes were generated. During this process, all duplicate codes were removed, with the open codes copied and pasted into a new Excel worksheet. Therefore, the researcher was able to facilitate the clean removal of the codes from the raw data. Table 3-6 shows the relationship between the summary codes and the open codes.

Table 36-3: Open Codes Developed from Summary Codes

Summary Codes	Open Codes
Pay premium for milk suppliers	Quality
People like new things	Adapting to client needs
Personal awards show business reputation	Recognition
Personal relationships with suppliers	Socialize
Philosophy is never to exceed threshold	Safety mechanism
Philosophy was local & handmade	Authentic
Place snapshot of story on Ch tasting notes	Information simplicity
Pleasantly surprised by Ch-making process	Unfamiliar
Poor milk supply affected MPF production	Production barriers
Poor milk supply leads to little or no Ch production	Production barriers
Post-recall story may be helpful	Recall recovery
Premium producers not foolproof	Common problem
Price reduction after a recall is bad	Counterproductive post-recall action
Problem was inconsistency in business	Inconsistencies

Problem was inconsistency in Chs	Inconsistencies
Problem with difficult distributor with rigid FSS	Distributor problems

36.1.3.3 Axial Coding

The process of axial coding has helped in abstracting the open codes to a higher level (Bernard and Ryan, 2009), thus moving the open code labels to a concept. Drawing on Corbin and Strauss (1990), the researcher ensured the data led the analysis by incorporating the context of the underlying concepts during the process of naming and framing the category. Therefore, the axial coding pulled the basic concepts, which were developed through the open coding, together into categories, which led to the collection of comparable conceptual themes. At this stage, the axial codes had not formed the final themes, but they became the sub-components of the process. The final level of analysis commenced after the concepts were formed into axial codes. In the Preliminary stage, Phase one – Investigating Knowledge Gaps – Firm Perspective, a total of 22 final axial codes were developed. Table 3-7 below shows the process of iteration during the axial coding process.

Table 36-4: Axial Coding with Multiple Iterations

Axial Code (First Iteration)	Axial Code (Second Iteration)
No experience of recall	Experience
Non-electronic media coverage	Information Coverage
Openness	Transparency
Opportunity	Opportunity
Outsmart competitor	Competitiveness
Outsourcing problems	Outsourcing problems
Packaging limitations	Packaging limitations
Pallet differences	Personalization
Paper based records	Record keeping
Perceived control	Control
Perception	Perception

At this stage of the coding, the axial codes underwent a number of iterations in order to build upon the refining and focusing of themes (Wong and San Hu, 2011, Tuckett, 2005). The multiple iterations were applied to the axial codes instead of the theme level of analysis, thus taking a pragmatic approach towards the data reduction concept described by Miles and Huberman (1994). Also, unlike the method applied by Tuckett (2005), the evolution of the codes occurred before the themes were generated without bias from the literature. The iterations were incremental in nature and they gradually abstracted from the previous iteration, in a way that prevented misinterpretation of the data. The advantage of this process is that it addressed the limitation of thematic coding by drawing on the strengths of grounded theory principles. Thematic analysis has been criticised for its lack of constant comparisons (Boyatzis, 1998), but the principles of grounded theory draws on the constant comparison method (Corbin and Strauss, 1990). The iterative process reduced the 116 initial axial codes to 22 final axial codes. Table 3-8 below shows the open codes and the final axial codes.

Table 36-5: Final Axial Codes

Open Codes	Final Axial Codes
Norm	Conventional
Opportunity	Compromise
Outsourcing problems	Control
Packaging limitations	Compromise
Perception	Investigative actions
Personalization	Engagement
Platform variety	Information dissemination
Policy Evaluation	Control
Practice	Conventional
Preservation	Authenticity
Price fixing	Control
Proactive marketing	Business Agility
Problem discovery	Investigative actions
Procedures	Control
Product imitation	Authenticity

36.1.3.4 Theme Development

This stage of the data analysis involved creating the final level themes by looking at the attributes of each of the axial codes. As described by Attride-Stirling (2001), each of the themes hold the principal metaphors of the entire dataset as they are illustrative of the underlying codes. There was a constant review of the raw data, the codes generated and the final themes as Braun and Clarke (2006) have discussed the process of thematic analysis. The process of multiple iterations was important in producing meaningful themes which concluded the data analysis process.

In order to facilitate the grouping of the axial codes where similar concepts were apparent, the researcher printed the axial codes onto small slips. The researcher made multiple attempts at grouping the axial codes in order to ensure the new groupings were generated through a culmination of obvious groupings and new discoveries of concepts. After the generation of the final themes, the researcher again re-assessed the axial codes to ensure that they indeed linked to the themes. Figure 3-7 below illustrates the final grouping of a theme from the Preliminary stage, Phase one – **Investigating Knowledge Gaps – Firm Perspective**.

Axial Code	Theme
Authenticity	Authenticity
Conventional	
Expertise	
Knowledge acquisition	
Niche market	

Figure 36-3: Final Theme for Preliminary Stage, Phase One

A total of three themes were developed within this stage. Figure 3-8 below shows the themes for the Preliminary Stage, Phase one – **Investigating Knowledge Gaps – Firm Perspective**.

Themes for Phase one, Stage one – Foundation Seeking – Firm Perspective
Authenticity
Branding

Business Agility

Figure 36-4: Themes developed for Preliminary Stage, Phase One

Figure 3-9 below illustrates the final grouping of a theme from Phase two – **Design and Development of the Safe Food Management App**.

Axial Code	Theme
Ethical Perception	Content
Information Content	
Information Tone	
Value Add	

Figure 36-5: Final Grouping for a Theme in Phase Two

A total of four themes were developed within this stage. Figure 3-10 below shows the themes for Phase two – **Design and Development of the Safe Food Management App**.

Themes for Phase two – Design and Development of the Safe Food Management App
Access
Content
Design
Search

Figure 36-6: Themes developed for Phase Two

This section has presented the method of analysis used in the research. The researcher developed themes that were abstracted while still retaining its inductive nature by utilising the thematic analysis technique which drew on the principles of grounded theory – inductive approach.

37 APPENDIX AB - QUESTIONNAIRE

This section describes the demography of the participants and provides the descriptive analysis of the smartphone usage of the participants and the descriptive analysis of the meat related questions. This was done to ensure the participants indeed met the inclusion criteria and to provide some background information about the participants. Therefore, the three sub-sections are demography, smartphone usage and meat-related questions.

37.1 Demography of the Participants

This sub-section presents the demographic data of the participants. All the respondents live in Australia and are above 18 years of age. There were a total of nine participants consisting of 4 males and 5 females. All participants have acquired more than basic education and are therefore categorised as literates, as shown in Figure 5-1. The participants span across the three major age ranges of 18 to 29, 30 to 49 as well as 50 and above, as shown in Figure 5-2.

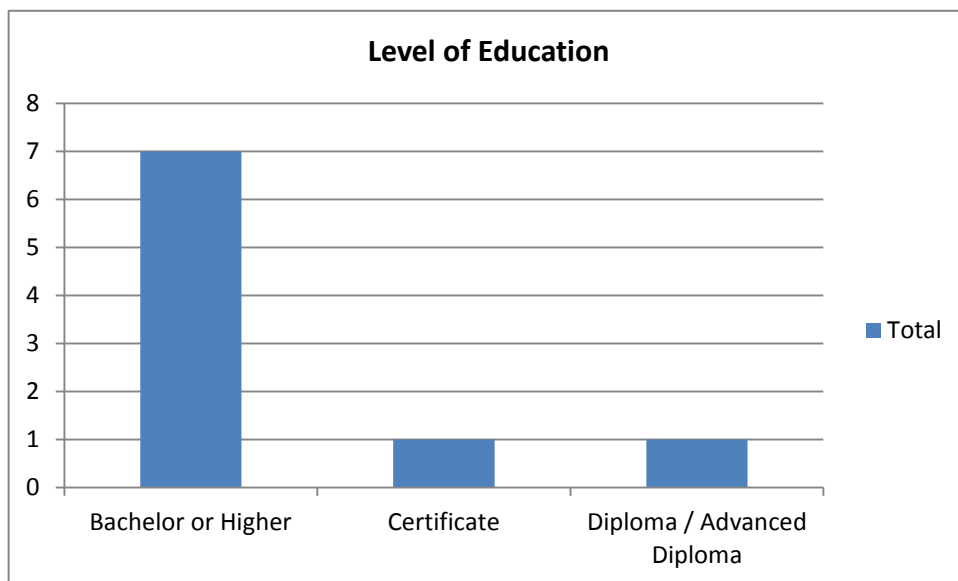


Figure 37-1: Demography - level of education

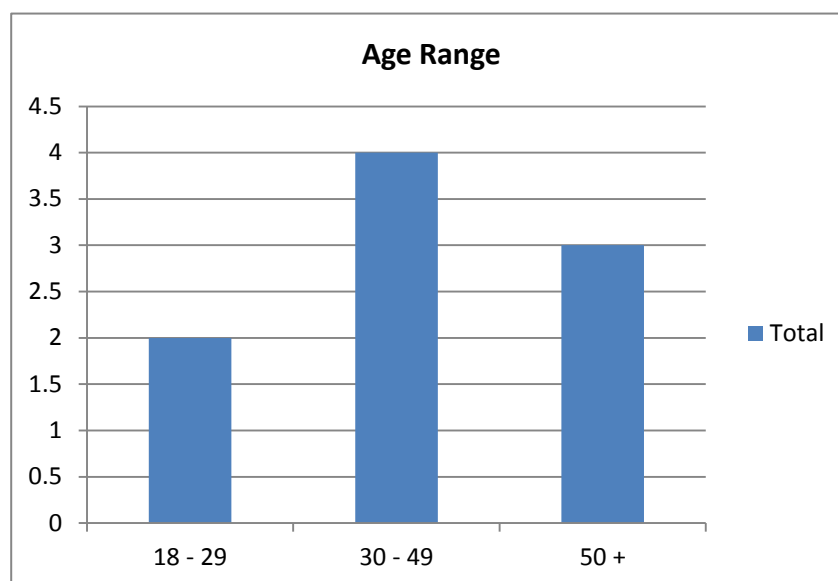


Figure 37-2: Demography – age range

The next sub-section discusses the analysis of the screening questions.

37.2 Smartphone Usage

This sub-section presents the findings of the questions related to participants' smartphones and how much the participants use their smartphones. All the participants own and use a smartphone. All the participants use social media tools such as Facebook or Twitter. The types of smartphones they use are iPhone 4s, iPhone 5, Samsung and Sony Xperia. About 45% of the participants have owned a smartphone for more than 4 years, about 45% have owned a smartphone for more than 2 years but less than 4 years and only 10% have owned a smartphone for more than 1 year but less than 2 years. However, for the current smartphone the participants used during the session, the length of time the participants have used with the phone is shown in Figure 5-3. The figure shows that some of the participants have recently changed their phone, probably due to the frequent advancement in mobile technology.

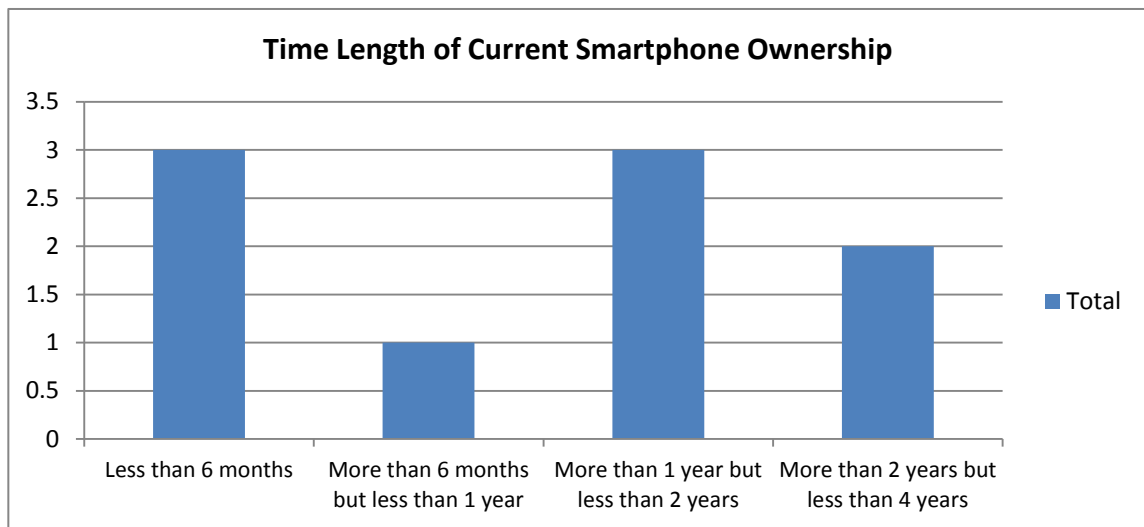


Figure 37-3: Smartphone use – time length

Based on a 5-point Likert scale, the participants were asked to rate their use of smartphones from Light to Heavy. Figure 5-4 shows that almost half of the participants rated themselves as medium/average smartphone users.

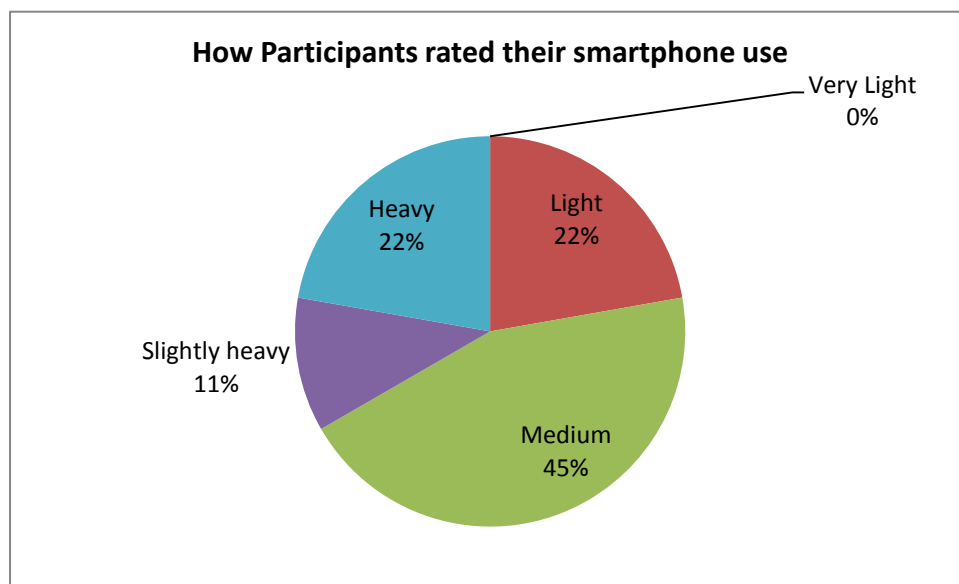


Figure 37-4: Smartphone use – participant's ratings

To verify the participants' responses to the preceding questions, they were asked to provide the average time they typically spend using their smartphones per day. The response provided in Figure 5-5 verifies their responses to the preceding question.

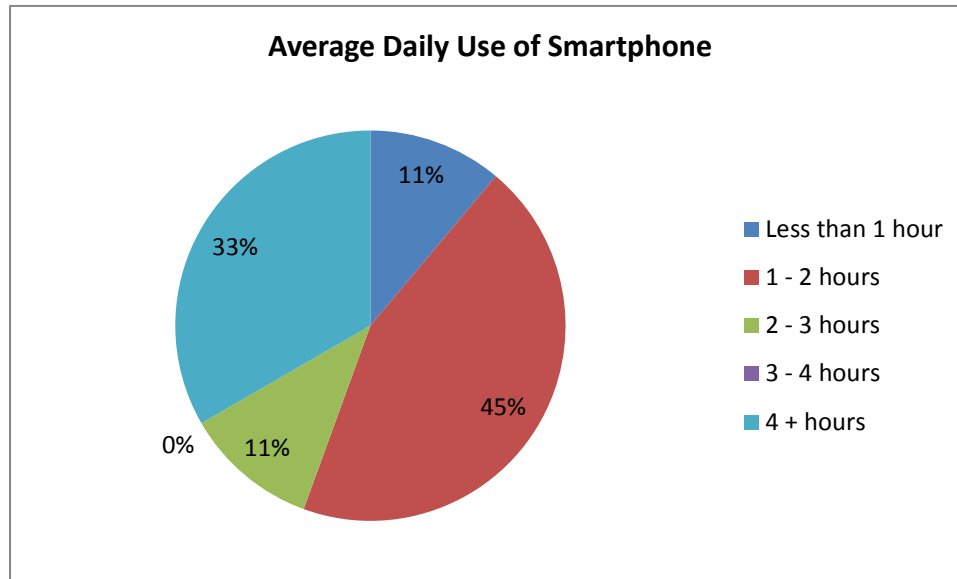


Figure 37-5: Smartphone use – average daily use

Furthermore, the participants were asked to specify the various purposes for which they use their smartphones. As shown in Table 5-2, the findings indicate that participants mostly utilise their phones for making calls, social networking and productivity such as calendars.

Table 37-1: Purpose of using smartphones

\$SmartphonePurpose Frequencies					
			Responses		Percent of Cases
			N	Percent	
Purpose of using Smartphone ^a	Calling People		8	19.0%	88.9%
	Games		3	7.1%	33.3%
	Weather		5	11.9%	55.6%
	Social Networking		7	16.7%	77.8%
	Music		3	7.1%	33.3%
	Productivity		6	14.3%	66.7%
	News		3	7.1%	33.3%
	Shopping		1	2.4%	11.1%
	Video or Movies		1	2.4%	11.1%
	Surfing the web		5	11.9%	55.6%
Total			42	100.0%	466.7%

a. Dichotomy group tabulated at value 1.

However, two of the participants also specified “work” as one of the other reasons why they use a smartphone, another specified “study or flashcards” and one more mentioned “texting” as one of the other purposes for which they use a smartphone.

When asked about their favorite smartphone application, the responses of the participants varied as they mentioned apps such as;

- Camera & Google,
- Apple weather,
- Instagram,
- Facebook messenger,
- Words with friends,
- Tripcase/Tripadvisor,
- AnkiDroid
- Mail.

It was however interesting to note that 3 of the 8 apps mentioned are mainly for social networking – connecting with people.

Finally, the participants were asked if they had downloaded any apps within the past week and 5 of the participants said “yes”. Of these 5 participants, they had downloaded about 1 to 4 apps during the week (excluding the apps used for the study).

37.3 Meat related Questions

This sub-section presents the findings of the meat related questions posed to the participants. Firstly, they were asked about their dietary intake. The findings indicate that 8 of the 9 participants had a mixed diet which includes red and white meat. However, the ninth participant who is primarily a vegetarian was allowed to attend the session in case there was a low turn-out of participants. The participant’s insights were deemed valuable because of the very low technological skills she had.

Secondly, the participants were asked about where they usually buy their fresh meat products. About 45% of the participants specified fresh food markets or butchers; about 33% specified supermarkets while 11% specified delicatessens.

Finally, the participants were asked to specify how often they cook meat. This question helps to verify the responses provided to the preceding two questions. The findings

indicate that about 67% of the participants cook meat at least once in a week while only 22% cook meat at least once a fortnight.

In summary, the findings of the questionnaire have provided a broad overview of the type of respondents that participated in the focus group session. More importantly, it has been revealed that the participants' skillset range from very low technological skills to high technological skills which provided a broad insight into information presentation preferences across a diverse range of users.

38 APPENDIX AC - ASSESSING INDIVIDUAL PARTICIPANT DURING AND AFTER THE EXPERIMENT

As the participants perceived behavioural change was assessed six weeks after the experiment for each individual, this provided a clear picture of the impact of the experiment for each participant. Therefore, the attributes for each participant, and their progress throughout each phase of the pre-experiment, experiment and post-experiment, will be discussed in the following eight vignettes.

38.1.1 Vignette 1: Participant ACJ

ACJ is a male participant who is above 50 years old. He is well-educated as he has acquired more than a Bachelor's degree. He lives in Hobart, Tasmania. He has been using different types of smartphones for more than 4 years so he is confident in the usage of smartphones. He currently has an iPhone 4s which he has been using for more than a year but less than two years. He considers himself a medium smartphone user as he uses his phone for only one to two hours per day. He mainly uses his mobile phone to make calls; his favourite smartphone app is Apple Weather but he sometimes uses his smartphone for social networking. He does not appear to be someone who frequently downloads apps as he had not downloaded any app in the week preceding this investigation. In addition, ACJ is someone who likes to purchase his fresh meat products from supermarkets. He cooks meat frequently; at least once a week. He has a mixed diet which includes red and white meat.

In the first week of the experiment, ACJ filled the baseline questionnaire and he could only get half of the answers correctly; thus scoring 50%. As he was randomly assigned to the experimental group, he had to use the app on the first day of the experiment to learn the correct answers to the questions. After this, he listened to other members of the group as they discussed what they had learnt and he also shared what he had learnt. Between week one and two, he revised the app once for 5 to 10 minutes. By the second week of the experiment, when he was given the same questionnaire, he was able to get all the answers correctly; thus scoring 100%. Between week two and three, he did not revise the app at all; perhaps because he felt he had acquired all the required knowledge. By the third week of the experiment, the question style had changed to scenario-based question which used recipe information, thus it was imperative to know how conversant

he was with the use of recipe information. He had used recipe books and online recipes for more than 10 times and less than 20 times. At this stage, the answers he provided to the four questions were not very satisfactory, which led to him being scored 65%. Whilst this was lower than the score of the preceding week, he had gained a fair amount of knowledge between the first week and the third week. Between week three and four, he did not revise the app again. By the fourth week of the experiment, the question style had changed to use a live kitchen environment. At this stage, the answers he provided to the four questions, though different from the previous week, had improved which led him to being scored 80%.

By the end of the four-week experiment, he believed the app helped him in learning because it provided *“easy access to required information”*, it used *“graphics which helped to provide better explanation”* and it *“confirmed or rejected previous beliefs”*. However, he believed, it would have been better to have both information and/or knowledge acquisition tools (app and paper-based tool), so as to benefit from their strengths. As far as he is concerned, the app is quick, convenient and easily updated but the document would be easier to skim for information. In addition, he believed he had learnt about the following: *“correct hand washing technique; correct hand drying technique; correct storage locations in the refrigerator to avoid cross contamination; how to tell if meat is cooked and safe to eat; and correct use of chopping board and knife to avoid cross contamination”*. However, he only intended to make one change to his day-to-day kitchen activities as he had learnt that *“chicken should be stored in a fridge immediately”*.

Six weeks after the completion of the experiment, ACJ was contacted by phone and he was asked to answer ten questions drawn from the initial baseline questionnaire. As the questions and answer options were read to him, he was asked to identify the correct answer. He was able to answer most of the questions appropriately; thus scoring 90%. He also revealed that he had not revised the app or document throughout the 6-week period. However, he was able to implement some changes in his day-to-day activities in the following ways: *“Before, I used to leave food on the bench top for long but now I put it straight in the fridge”*; and *“I am now more particular about washing utensils in hot water whereas I used to just do a quick rinse or wipe before”*. It was interesting to note that the first change he mentioned is aligned to the initial intention he had in terms of the

changes he wanted to make to his day-to-day kitchen activities in the preceding six weeks. The changes in the quantitative results across the initial four-week period and the subsequent six-week period are shown in Figure 6-6.

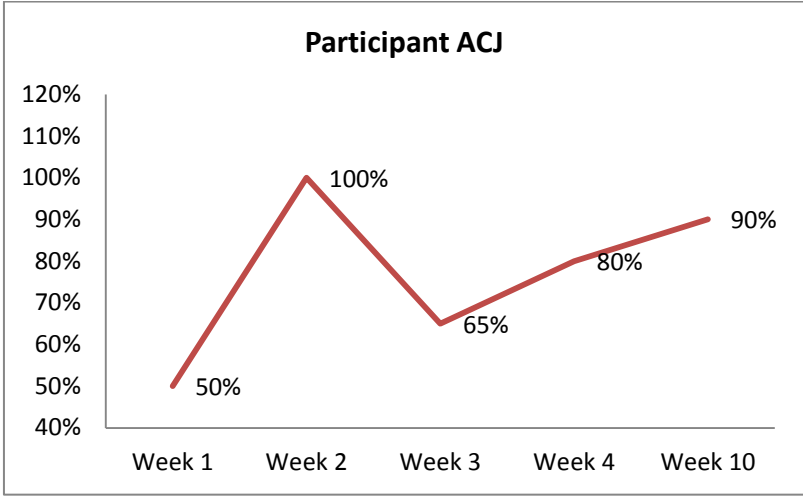


Figure 38-1: Participant ACJ's knowledge optimisation transition

Therefore, this suggests that ACJ's knowledge was successfully optimised as he was able to: demonstrate 'remembrance' to indicate that he did not just receive the information provided by the app but he also acquired the knowledge by assimilating it; demonstrate 'understanding' to indicate that he had retained some of the knowledge; and demonstrate 'application' to indicate that he could apply some of the knowledge acquired. This implies that the knowledge optimisation that occurred to ACJ is one of the major factors that led to his perceived behavioural change in his day-to-day kitchen activities.

38.1.2 Vignette 2: Participant ACC

ACC is a female participant who is above 50 years old. She has a Diploma or an advanced Diploma. She lives in Hobart, Tasmania. She has been using different types of smartphones for more than 2 years but less than 4 years. She currently has a Samsung S5 which she has been using for more than a year but less than two years. She considers herself a light smartphone user as she uses her phone for less than an hour per day. She mainly uses her mobile phone for calling people, games, weather, social networking, music and productivity, and her favourite smartphone app is Words with Friends. She does not appear to be someone who frequently downloads apps as she had not downloaded any app in the week preceding this investigation. In addition, ACC is

someone who likes to purchase her fresh meat products from delicatessens. She cooks meat frequently; at least once a week. She has a mixed diet which includes red and white meat.

In the first week of the experiment, ACC filled the baseline questionnaire and she could get many of the answers correctly; thus scoring 80%. As she was randomly assigned to the experimental group, she had to use the app on the first day of the experiment to learn the correct answers to the questions. After this, she listened to other members of the group as they discussed what they had learnt and she also shared what she had learnt. Between week one and two, she revised the app three times for 5 to 10 minutes each. By the second week of the experiment, when she was given the same questionnaire, she was able to get more answers correctly; thus scoring 90%. Between week two and three, she revised the app once for 5 to 10 minutes. By the third week of the experiment, the question style had changed to scenario-based question which used recipe information, thus it was imperative to know how conversant she was with the use of recipe information. She had used recipe books, online recipes, TV shows and recipe information from cooking classes and friends & family for more than 20 times. At this stage, the answers she provided to the four questions were somewhat satisfactory, which led to her being scored 87.5%. Whilst this was lower than the score of the preceding week, she had gained some knowledge between the first week and the third week. Between week three and four, she did not revise the app at all. By the fourth week of the experiment, the question style had changed to use a live kitchen environment. At this stage, the answers she provided to the four questions, though different from the previous week, had improved which led her to being scored 100%.

By the end of the four-week experiment, she believed the app helped her in learning because it *“made it easier and quicker to locate information”* and it made her *“more likely to explore the app and therefore access more information”*. However, she believed, she would have preferred to use a paper-based tool *“as it is easy to flick back and forth and also make notes or bookmark useful information”*. As far as she is concerned, she thinks she is *“not totally smartphone literate”* and she *“often finds the text too small to read”*. In addition, she believed she had learnt about the following: *“even if chicken smells good, if not hot or over 70C, refrigerate within 1 hour for bacteria not to flourish; hand washing technique; use of search function within app to*

access wider range of information; food storage guidelines for keeping frozen food and cover everything in fridge preferably in sealed containers". Having learnt all these, she only intended to make changes to her day-to-day kitchen activities by *"refrigerating food much more quickly"* and by using *"paper towels rather than tea towels"* or by *"washing tea towels more quickly"*.

Six weeks after the completion of the experiment, ACC was contacted by phone and she was asked to answer ten questions drawn from the initial baseline questionnaire. As the questions and answer options were read to her, she was asked to identify the correct answer. She was able to answer most of the questions appropriately; thus scoring 90%. She also revealed that she had not revised the app or paper-based tool throughout the 6-week period. However, she was able to implement some changes in her day-to-day activities in the following ways: *"on Sunday I cooked something, I normally let it cool on the benchtop but now I am more aware so I put it away immediately, so I don't leave food out in the open"*; *"I heated food in the microwave and I had to put it back in because it wasn't steaming hot. So, I now make sure things are heated to the right temperature."*; *"I now make sure meat is at the bottom of the fridge"*. It was interesting to note that the first change she mentioned is aligned to the initial intention she had in terms of the changes she wanted to make to her day-to-day kitchen activities in the preceding six weeks. The changes in the quantitative results across the initial four-week period and the subsequent six-week period are shown in Figure 6-7.

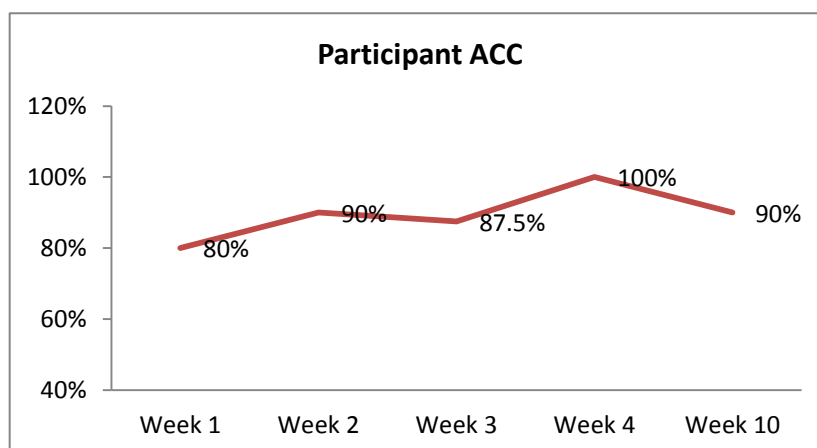


Figure 38-2: Participant ACC's knowledge optimisation transition

Therefore, this suggests that ACC's knowledge was optimised as she was able to: demonstrate 'remembrance' to indicate that she did not just receive the information

provided by the app but she also acquired the knowledge by assimilating it; demonstrate ‘understanding’ to indicate that she had retained some of the knowledge; and demonstrate ‘application’ to indicate that she could apply some of the knowledge acquired. This implies that the knowledge optimisation that occurred to ACC is one of the major factors that led to her perceived behavioural change in her day-to-day kitchen activities.

38.1.3 Vignette 3: Participant ACH

ACH is a female participant who is between 30 and 49 years old. She is well-educated as she has acquired more than a Bachelor’s degree. She lives in Hobart, Tasmania. She has been using different types of smartphones for more than 4 years so she is confident in the usage of smartphones. She currently has an iPhone 5S which she has been using for more than two years but less than four years. She considers herself a heavy smartphone user as she uses her phone for more than three hours but less than four hours per day. She mainly uses her mobile phone for social networking, productivity, news, shopping and surfing the web, and her favourite smartphone app is Instagram. She appears to be someone who frequently downloads apps as she had downloaded an app in the week preceding this investigation. In addition, ACH is someone who likes to purchase her fresh meat products from fresh food markets and butchers. She cooks meat frequently; at least once a week. She has a mixed diet which includes red and white meat.

In the first week of the experiment, ACH filled the baseline questionnaire and she could get most of the answers correctly; thus scoring 90%. As she was randomly assigned to the experimental group, she used the app on the first day of the experiment to learn the correct answers to the questions. After this, she listened to other members of the group as they discussed what they had learnt and she also shared what she had learnt. Between week one and two, she revised the app two times for 5 to 10 minutes each and even discussed it and showed someone the app. By the second week of the experiment, when she was given the same questionnaire, she was not able to get as many correct answers; thus scoring 80%. Perhaps, this was due to the fact that she felt she was more confident of her safe food management knowledge. Between week two and three, she revised the app once for 5 to 10 minutes. By the third week of the experiment, the question style had changed to scenario-based questions which used recipe information, thus it was imperative to know how conversant she was with the use of recipe information. She had

used recipe books, online recipes and TV shows for more than 20 times. At this stage, the answers she provided to the four questions were satisfactory, which led to her being scored 95%. Whilst this was a major improvement when compared to the score of the preceding week, she had only gained a slight increase in knowledge between the first week and the third week. Between week three and four, she revised the app two times for 5 to 10 minutes each. By the fourth week of the experiment, the question style had changed to use a live kitchen environment. At this stage, the answers she provided to the four questions, though different from the previous week, was not better than the previous week, which led her to being scored 95%.

By the end of the four-week experiment, she believed the app helped her in learning because it *“is easy to access during reuse”* and it *“is easy to navigate after first use”*. However, she believed, she would not have preferred to use a paper-based tool *“as she likes visuals to go with learning”* and she *“likes to use search terms rather than read through a document”*. In addition, she believed she had learnt about the following: *“Correct temperature for freezer is -18°C ; wash hands for at least 40s; cooked meat shouldn't be left out for longer than 30 minutes before its put in the fridge; fridge temperature should be about 3°C and; burger should have an internal temperature of about 80°C ”*. However, out of the five points she mentioned, three of them are incorrect; thus questioning whether she had indeed acquired the knowledge. Furthermore, she intended to make changes to her day-to-day kitchen activities by *“washing hands more often and for longer”*, *“always having paper towel available”*, *“putting cooked food straight in the fridge if not eating straight away”*, and by *“checking freezer temperature regularly”*.

Six weeks after the completion of the experiment, ACH was contacted by phone and she was asked to answer ten questions drawn from the initial baseline questionnaire. As the questions and answer options were read to her, she was asked to identify the correct answer. She was able to answer most of the questions appropriately; thus scoring 90%. She also revealed that she had not revised the app or paper-based tool throughout the 6-week period. However, she was able to implement only one change in her day-to-day activities in the following way: *“I am a little more aware of washing things rather than just rinsing them under hot water”*. It was interesting to note that the change she mentioned is not aligned to the initial intention she had in terms of the changes she

wanted to make to her day-to-day kitchen activities in the preceding six weeks. The changes in the quantitative results across the initial four-week period and the subsequent six-week period are shown in Figure 6-8.

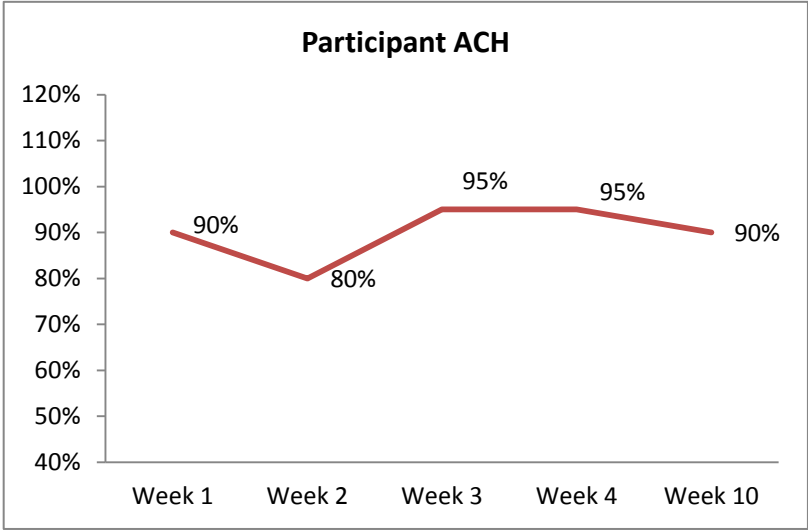


Figure 38-3: Participant ACH's knowledge optimisation transition

Therefore, this suggests that ACH's knowledge was not necessarily optimised as she was not able to demonstrate 'remembrance' to indicate that she did not just receive the information provided by the app but she also acquired the knowledge by assimilating it. However, she was able to demonstrate sufficient 'understanding' to indicate that she had retained some knowledge; and demonstrate 'application' to indicate that she could apply most of the knowledge acquired. As minor changes occurred to her knowledge levels, this however implies that any knowledge optimisation that occurred to ACH may not necessarily be the factor that led to her perceived behavioural change in her day-to-day kitchen activities.

38.1.4 Vignette 4: Participant ACM

ACM is a male participant who is between 30 and 49 years old. He is well-educated as he has acquired more than a Bachelor's degree. He lives in Hobart, Tasmania. He has been using different types of smartphones for more than 2 years but less than 4 years. He currently has an HTC M8 which he has been using for more than 6 months but less than a year. He considers himself a medium smartphone user as he uses his phone for only one to two hours per day. He mainly uses his mobile phone for games, weather, social networking, productivity, video or movies and his favourite smartphone app is YouTube but he sometimes uses his smartphone for social networking. He appears to be someone

who frequently downloads apps as he had downloaded an app in the week preceding this investigation. In addition, ACM is someone who likes to purchase his fresh meat products from supermarkets. He cooks meat frequently; at least once a week. He has a mixed diet which includes red and white meat.

In the first week of the experiment, ACM filled the baseline questionnaire and he could only get less than half of the answers correctly; thus scoring 45%. As he was randomly assigned to the experimental group, he used the app on the first day of the experiment to learn the correct answers to the questions. After this, he listened to other members of the group as they discussed what they had learnt and he also shared what he had learnt. Between week one and two, he revised the app two times for 10 to 15 minutes each and discussed what he had learnt with family and friends. By the second week of the experiment, when he was given the same questionnaire, he was able to get many of the answers correctly; thus scoring 80%. Between week two and three, he revised the app once for 5 to 10 minutes and did not only discuss what he had learnt with family and friends but corrected someone's food handling practice. By the third week of the experiment, the question style had changed to scenario-based questions which used recipe information, thus it was imperative to know how conversant he was with the use of recipe information. He had used recipe books and online recipes for more than 10 times and less than 20 times. At this stage, the answers he provided to the four questions were very satisfactory, which led to him being scored 90%. This indicates that he had doubled the amount of knowledge he had between the first week and the third week while he was consistent with using the app for revisions. However, between week three and four, he did not revise the app at all. By the fourth week of the experiment, the question style had changed to use a live kitchen environment. At this stage, the answers he provided to the four questions, though different from the previous week, were not satisfactory which led him to being scored 52.5%. Perhaps, this was due to his deviation from the use of the app, as he had performed much better whenever he revised the app during the course of the week.

By the end of the four-week experiment, he believed the app helped him in learning because it "*was easy to use*" and it "*contained useful information*". However, he believed, he would have preferred to use a paper-based tool. As far as he was concerned, whilst "*the app is really easy to use*", the paper-based tool was preferable for

him because reading documents is his “*hobby*”. In addition, he believed he had learnt about the following: “*fridge arrangement; cooking procedures, how to wash hands properly; to always check using app or internet if uncertain and to enjoy cooking and safety of food*”. However, he only intended to make changes to his day-to-day kitchen activities in the following ways: “*fridge arrangement; remembering to wash hands and dry with paper towel; and the cleaning of kitchen after use*”.

Six weeks after the completion of the experiment, ACM was contacted by phone and he was asked to answer ten questions drawn from the initial baseline questionnaire. As the questions and answer options were read to him, he was asked to identify the correct answer. He was able to answer some of the questions appropriately; thus scoring 70%. He also revealed that he had revised the paper-based tool twice across the 6-week period. Perhaps, this was what helped him to improve in his food safety knowledge. Also, he was able to implement some changes in his day-to-day activities in the following ways: “*I changed in the kitchen by buying multiple coloured chopping boards*”; and “*I now wash hands more after cutting meat and any raw ingredient*”. It was interesting to note that the second change he mentioned is aligned to the initial intention he had in terms of the changes he wanted to make to his day-to-day kitchen activities in the preceding six weeks. The changes in the quantitative results across the initial four-week period and the subsequent six-week period are shown in Figure 6-9.

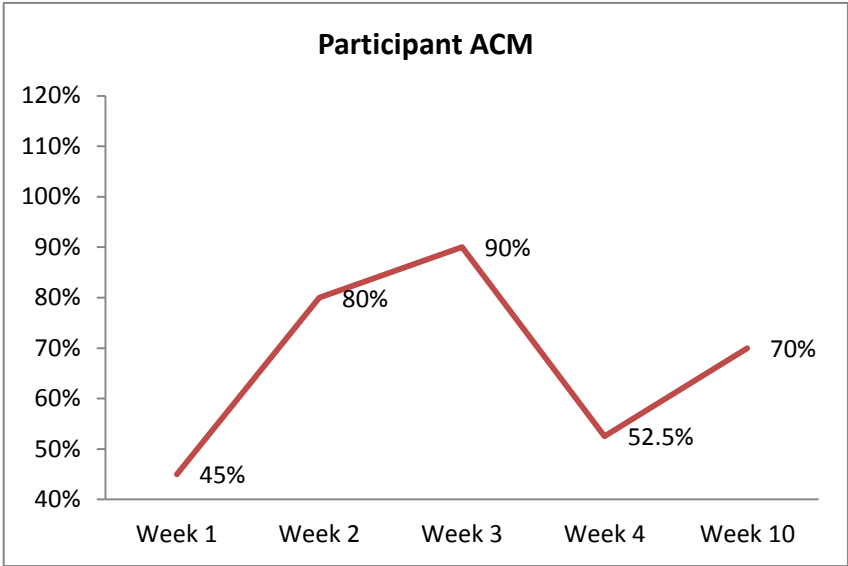


Figure 38-4: Participant ACM's knowledge optimisation transition

Therefore, this suggests that ACM's knowledge was successfully optimised, despite his tendency to be reliant on any of the information and/or knowledge acquisition tools which was revealed through the huge decline in Week 4 due to the deviation from the use of the app in the preceding week. Nonetheless, he was able to: demonstrate 'remembrance' to indicate that he did not just receive the information provided by the app but he also acquired the knowledge by assimilating it; demonstrate 'understanding' to indicate that he had retained some of the knowledge; and demonstrate 'application' to indicate that he could apply some of the knowledge acquired. This implies that the knowledge optimisation that occurred to ACM is one of the major factors that led to his perceived behavioural change in his day-to-day kitchen activities.

38.1.5 Vignette 5: Participant DCW

DCW is a male participant who is between 30 and 49 years old. He is well-educated as he has acquired more than a Bachelor's degree. He lives in Hobart, Tasmania. He has been using different types of smartphones for more than 4 years so he is confident in the use of smartphones. He currently has an iPhone 4 which he had been using for more than four years. He considers himself a medium smartphone user as he uses his phone for less than an hour per day. He mainly uses his mobile phone for calling people, weather, productivity and news and his favourite smartphone app is ABC News app but he sometimes uses his smartphone for social networking. He does not appear to be someone who frequently downloads apps as he had not downloaded any app in the week preceding this investigation. In addition, DCW is someone who likes to purchase his fresh meat products from supermarkets. He cooks meat frequently; at least once a week. He has a mixed diet which includes red and white meat.

In the first week of the experiment, DCW filled the baseline questionnaire and he could get most of the answers correctly; thus scoring 90%. As he was randomly assigned to the control group, he had to use the paper-based tool on the first day of the experiment to learn the correct answers to the questions. After this, he listened to other members of the group as they discussed what they had learnt and he also shared what he had learnt. Between week one and two, he did not revise the document, perhaps because he felt he had sufficient knowledge. However, he did discuss the food safety details with his

friends and family. By the second week of the experiment, when he was given the same questionnaire, he was able to get all the answers correctly; thus scoring 100%. Between week two and three, he did not revise the document but he discussed about the food safety details with friends and family again. By the third week of the experiment, the question style had changed to scenario-based question which used recipe information, thus it was imperative to know how conversant he was with the use of recipe information. He had used recipe books, online recipes and learnt recipe information from friends and family for more than 10 times and less than 20 times. At this stage, the answers he provided to the four questions were not as satisfactory as expected, which led to him being scored 82.5%. Whilst this was lower than the score of the preceding week, he had indeed declined between the first week and the third week. Between week three and four, he revised the paper-based tool once for less than 5 minutes. By the fourth week of the experiment, the question style had changed to use a live kitchen environment. At this stage, the answers he provided to the four questions, though different from the previous week, had improved which led him to being scored 92.5% which was only slightly better than his score in the very first week.

By the end of the four-week experiment, he believed the document was very useful to him in the first week and that the paper-based tool is helpful because it provided “*an area for discussion at home which made him assess how he does things in his own life*” and through the discussion, he believes his “*eyes were opened*”. However, he believed, it would have been better to have an app. As far as he is concerned, he would like the app if it is “*easy to use*” and “*contains detailed information*”. In addition, he believed he had learnt about the following: “*Wash hands for 30 seconds; do not allow hot foods to be left on bench for longer than 1 hour; use glass containers to prevent odours passing between foods*”. However, he only intended to make one change to his day-to-day kitchen activities as he had learnt about “*the length of time of food if left seating on the bench before putting into the fridge*”.

Six weeks after the completion of the experiment, DCW was contacted by phone and he was asked to answer ten questions drawn from the initial baseline questionnaire. As the questions and answer options were read to him, he was asked to identify the correct answer. He was able to answer all the questions appropriately; thus scoring 100%. He also revealed that he had not revised the app or document throughout the 6-week period.

However, he was able to implement some changes in his day-to-day activities in the following ways: “Now, I have bought a meat thermometer and I especially focus on chicken in terms of having it hot enough because of the large amount of bacteria”; and “I checked the temperature of my fridge after the experiment to ensure it is at the right temperature”. It was interesting to note that none of the changes he mentioned is aligned to the initial intention he had in terms of the change he wanted to make to his day-to-day kitchen activities in the preceding six weeks. The changes in the quantitative results across the initial four-week period and the subsequent six-week period are shown in Figure 6-10.

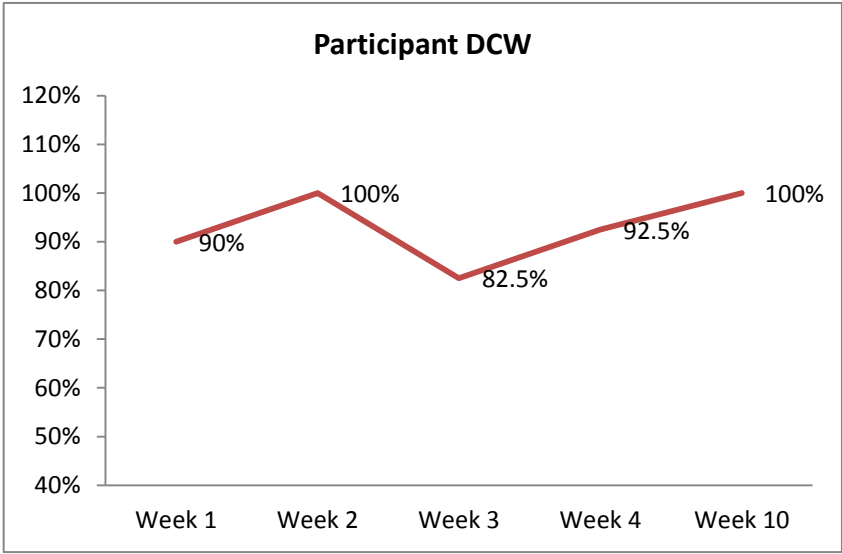


Figure 38-5: Participant DCW’s knowledge optimisation transition

Therefore, this suggests that DCW’s knowledge was only slightly optimised as he was able to: demonstrate ‘remembrance’ to indicate that he did not just receive the information provided by the document but he also acquired the knowledge by assimilating it; demonstrate some ‘understanding’ to indicate that he had retained some of the knowledge; and demonstrate ‘application’ to indicate that he could apply some of the knowledge acquired. This implies that the knowledge optimisation that occurred to DCW is one of the major factors that led to his perceived behavioural change in his day-to-day kitchen activities.

38.1.6 Vignette 6: Participant DCT

DCT is a female participant who is above 50 years old. She is well-educated as she has acquired more than a Bachelor’s degree. She lives in Hobart, Tasmania. She has been

using different types of smartphones for more than 4 years. She currently has an HTC incredible S which she has been using for more than 4 years. She considers herself a very heavy smartphone user as she uses her phone for more than 4 hours per day. She mainly uses her mobile phone for social networking but her favourite smartphone app is Google map. She does not appear to be someone who frequently downloads apps as she had not downloaded any app in the week preceding this investigation. In addition, DCT is someone who likes to purchase her fresh meat products from supermarkets. She cooks meat frequently; at least once a week. She has a mixed diet which includes red meat.

In the first week of the experiment, DCT filled the baseline questionnaire and she could only get a few of the answers correctly; thus scoring 65%. As she was randomly assigned to the control group, she used the paper-based tool on the first day of the experiment to learn the correct answers to the questions. After this, she listened to other members of the group as they discussed what they had learnt and she also shared what she had learnt. Between week one and two, she revised the document twice for 5 to 10 minutes each, discussed it with friends and family and even shared information from the document on social media. By the second week of the experiment, when she was given the same questionnaire, she was able to get all the answers correctly; thus scoring 100%. Between week two and three, she revised the document three times for 5 to 10 minutes each and she also discussed it with friends and family. By the third week of the experiment, the question style had changed to scenario-based questions which used recipe information, thus it was imperative to know how conversant she was with the use of recipe information. She had used recipe books and online recipes for more than 20 times. At this stage, the answers she provided to the four questions were not very satisfactory, which led to her being scored 62.5%. This was not only lower than the score of the preceding week but also lower than that of the first week. Between week three and four, she revised the document three times for 10 to 15 minutes each, discussed it with friends and family and even shared information from the document on social media. By the fourth week of the experiment, the question style had changed to use a live kitchen environment. At this stage, the answers she provided to the four questions, though different from the previous week, failed to improve which led her to being scored 62.5% again.

By the end of the four-week experiment, she believed she had “*acquired the knowledge through the document and practiced what she learnt from it*”. However, she believed, she would have preferred to use an app “*because I think apps have many advantages. Beautiful, Convenient to find what I want to read*” and “*because “it is easy to save and to share with anyone”*”. In addition, she believed she had learnt about the following: “*The right temperature of freezer and fridge; if not eating the meat immediately, I should put them into the fridge until serving it; washing hands until 30seconds; cutting the meat until smaller pieces before I put them into the freezer; examining the meat doneness according to the thermometer, not examining it by time or texture colour*”. Having learnt all these, she only intended to make changes to her day-to-day kitchen activities by “*paying more attention to food safety*”, “*sharing what was learnt with family members in order to enhance the safety environment in my kitchen*” and by using “*using the useful utensils in her kitchen*”.

Six weeks after the completion of the experiment, DCT was contacted by phone and she was asked to answer ten questions drawn from the initial baseline questionnaire. As the questions and answer options were read to her, she was asked to identify the correct answer. She was able to answer many of the questions appropriately; thus scoring 70%. She also revealed that she had revised the document once a week throughout the 6-week period. In addition, she was able to implement some changes in her day-to-day activities in the following ways: “*What to do before cooking, especially handwashing. I never knew about hand washing for a long time and because I have a child it is important to avoid diseases*”; and “*I now put meat in small pieces before I put them in freezer*”. However, she did highlight that “*washing hands for a long time is a challenge but she is trying her best*”. It was interesting to note that none of the changes she mentioned is aligned to the initial intention she had in terms of the changes she wanted to make to her day-to-day kitchen activities in the preceding six weeks. The changes in the quantitative results across the initial four-week period and the subsequent six-week period are shown in Figure 6-11.

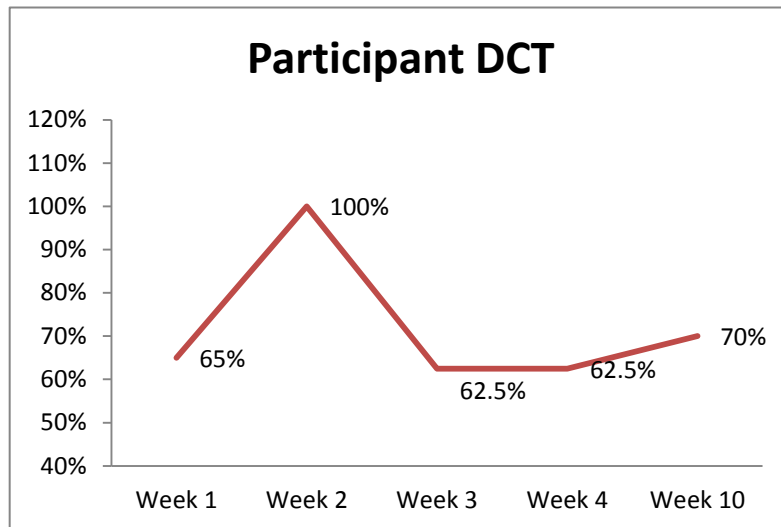


Figure 38-6: Participant DCT's knowledge optimisation transition

Therefore, this suggests that DCT's knowledge was not necessarily optimised as she was able to: demonstrate 'remembrance' to indicate that she did not just receive the information provided by the document but she also acquired the knowledge by assimilating it; but not able to demonstrate sufficient 'understanding' which indicates that she had not necessarily retained the knowledge; and she was also not able to demonstrate 'application' which indicates that she could not really apply the knowledge acquired. This implies that DCT's knowledge was not necessarily optimised though she was consistent with the revision of the document on a weekly basis. Perhaps, it was the frequent revision of the document that led to her perceived behavioural change in her day-to-day kitchen activities as she was able to eventually improve in her safe food management knowledge after the 10-week period.

38.1.7 Vignette 7: Participant DCV

DCV is a female participant who is between 30 and 49 years old. She is well-educated as she has acquired more than a Bachelor's degree. She lives in Hobart, Tasmania. She has been using different types of smartphones for more than 2 years but less than 4 years. She currently has an iPhone 4s which she has been using for more than 6 months but less than a year. She considers herself a medium smartphone user as she uses her phone for

about 1 to 2 hours per day. She mainly uses her mobile phone for calling people, weather and texting and she has no favourite smartphone app. She sometimes uses her phone for social networking. She does not appear to be someone who frequently downloads apps as she had not downloaded any app in the week preceding this investigation. In addition, DCV is someone who likes to purchase her fresh meat products from fresh food markets and butchers. She cooks meat at least once a fortnight and she has a mixed diet which includes red and white meat.

In the first week of the experiment, DCV filled the baseline questionnaire and she could only get a few of the answers correctly; thus scoring 60%. As she was randomly assigned to the control group, she used the paper-based tool on the first day of the experiment to learn the correct answers to the questions. After this, she listened to other members of the group as they discussed what they had learnt and she also shared what she had learnt. Between week one and two, she did not revise the document at all. By the second week of the experiment, when she was given the same questionnaire, she answered most of the questions correctly; thus scoring 95%. Between week two and three, she also did not revise the document at all. By the third week of the experiment, the question style had changed to scenario-based questions which used recipe information, thus it was imperative to know how conversant she was with the use of recipe information. She had used recipe books, online recipes and received recipe information from friends and family for more than 20 times. At this stage, the answers she provided to the four questions were somewhat satisfactory, which led to her being scored 87.5%. Whilst this was lower than the score of the preceding week it was however much higher than that of the first week. Between week three and four, she also did not revise the paper-based tool at all. By the fourth week of the experiment, the question style had changed to use a live kitchen environment. At this stage, the answers she provided to the four questions, though different from the previous week, had declined which led her to being scored 67.5%.

By the end of the four-week experiment, she believed she had “*only learnt from her past mistakes in reading through the first questionnaire*”, as she did not revise the paper-based tool throughout the 4-week period. However, she believed, she would have preferred to use an app “*for ease of access*” and she further explained that “*perhaps little chunks of information were provided in the app or a food structure where you can reach*

for particular topics rather than reading through a document to find the relevant section". In addition, she believed she had learnt about the following: *"minimum time to wash hands effectively or safely; air drying is best to avoid cross contamination; reheat food to steaming hot before serving leftover; place food for later consumption into the fridge immediately after cooking; in normal fridges, there is a part that is coldest which is best for storing meat"*. Having learnt all these, she intended to make changes to her day-to-day kitchen activities by *"letting dishes air dry; paying attention to length of hand wash and by refrigerating still hot food for later consumption"*.

Six weeks after the completion of the experiment, DCV was contacted by phone and she was asked to answer ten questions drawn from the initial baseline questionnaire. As the questions and answer options were read to her, she was asked to identify the correct answer. She was able to answer most of the questions appropriately; thus scoring 90%. She also revealed that she had not revised the document or app throughout the 6-week period. In addition, she was able to implement some changes in her day-to-day activities in the following ways: *"I now put warm food straightaway in the fridge. I don't leave them on the bench anymore"*; and *"I let dishes air dry rather than use a towel to dry them"*. It was interesting to note that both changes she mentioned are aligned to the initial intention she had in terms of the changes she wanted to make to her day-to-day kitchen activities in the preceding six weeks. The changes in the quantitative results across the initial four-week period and the subsequent six-week period are shown in Figure 6-12.

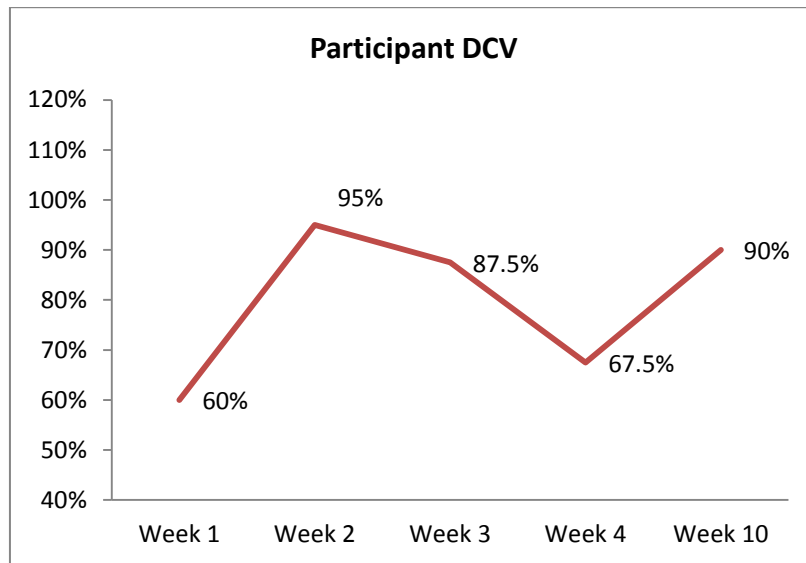


Figure 38-7: Participant DCV's knowledge optimisation transition

Therefore, this suggests that DCV's knowledge was optimised as she was able to: demonstrate 'remembrance' to indicate that she did not just receive the information provided by the paper-based tool on the first day of the experiment but she also acquired the knowledge by assimilating it; demonstrate 'understanding' to indicate that she had retained some of the knowledge; and demonstrate 'application' to indicate that she could apply some of the knowledge acquired. This implies that the knowledge optimisation that occurred to DCV is one of the major factors that led to her perceived behavioural change in her day-to-day kitchen activities.

38.1.8 Vignette 8: Participant DCH

DCH is a male participant who is between 18 and 29 years old. He is well-educated as he has acquired more than a Bachelor's degree. He lives in Hobart, Tasmania. He has been using different types of smartphones for more than 4 years so he is confident in the usage of smartphones. He currently has a Nokia Lumia (Windows) as well as an iPod Touch running iOS 6.1.6 which he has been using for more than two years but less than four years. He considers himself a light smartphone user as he uses his phone for less than an hour per day. He mainly uses his mobile phone for calling people, games, weather, social networking and productivity. In line with this, his favourite smartphone apps are Skype, 4 Pics 1 Word and Here Drive. He does not appear to be someone who frequently downloads apps as he had not downloaded any app in the week preceding this

investigation. In addition, DCH is someone who likes to purchase his fresh meat products from supermarkets. He cooks meat frequently; at least once a week. He has a mixed diet which includes red and white meat.

In the first week of the experiment, DCH filled the baseline questionnaire and he answered many of the questions correctly; thus scoring 80%. As he was randomly assigned to the control group, he had to use the paper-based tool on the first day of the experiment to learn the correct answers to the questions. After this, he listened to other members of the group as they discussed what they had learnt and he also shared what he had learnt. Between week one and two, he revised the paper-based tool once for less than 5 minutes. By the second week of the experiment, when he was given the same questionnaire, he was able to get all the answers correctly; thus scoring 100%. Between week two and three, he revised the paper-based tool once for 5 to 10 minutes. By the third week of the experiment, the question style had changed to scenario-based questions which used recipe information, thus it was imperative to know how conversant he was with the use of recipe information. He had used recipe books, online recipes and learnt recipe information from friends and family for more than 20 times. At this stage, the answers he provided to the four questions were quite satisfactory, which led to him being scored 92.5%. Whilst this was lower than the score of the preceding week, he had indeed improved between the first week and the third week. Between week three and four, he again revised the document once for 5 to 10 minutes. By the fourth week of the experiment, the question style had changed to use a live kitchen environment. At this stage, the answers he provided to the four questions, though different from the previous week, had slightly declined from the first three weeks which led him to being scored 75%.

By the end of the four-week experiment, he believed the document was helpful because it *“helped him learn well through reading and writing as a written format works well for him”*. However, he also said that *“there are certain forms of information that can be presented well in infographic form so pictures in those cases could help with retaining the information”*. In addition, he believed, it would have been better to have both the app and the paper-based tool as the information and/or knowledge acquisition tools. As far as he was concerned, he thinks having both tools would have helped because *“getting information in a variety of ways and from a variety of sources is a great way to*

remember it". He further stated that *"an advantage to the app would have been the ability to search the data more easily as specific facts can be hard to find in written documents. Furthermore, he believed he had learnt about the following: "hamburgers should be cooked to 75c and not just until brown; drying your hands with a towel is as bad as not having washed them at all; raw meat should be kept in the coldest part of the refrigerator, not just the lowest part; they should be frozen in smaller portions, not just in bulk; food should not be left on the bench for more than one hour"*. However, he intended to make changes to his day-to-day kitchen activities in the following ways; *"no more drying with towels; freeze smaller portions instead of bulk; put extras in the fridge immediately instead of after I eat it"*.

Six weeks after the completion of the experiment, DCH was contacted by phone and he was asked to answer ten questions drawn from the initial baseline questionnaire. As the questions and answer options were read to him, he was asked to identify the correct answer. He was able to answer all the questions appropriately; thus scoring 100%. He also revealed that he had revised the document twice throughout the 6-week period. More importantly, he was able to implement some changes in his day-to-day activities by: *"Storing things more separately in the fridge"*; *"putting food in small portions in the fridge"* and by *"using paper towels to dry hands rather than kitchen towels"*. It was interesting to note that the changes he mentioned are aligned to the initial intention he had in terms of the changes he wanted to make to his day-to-day kitchen activities in the preceding six weeks. The changes in the quantitative results across the initial four-week period and the subsequent six-week period are shown in Figure 6-13.

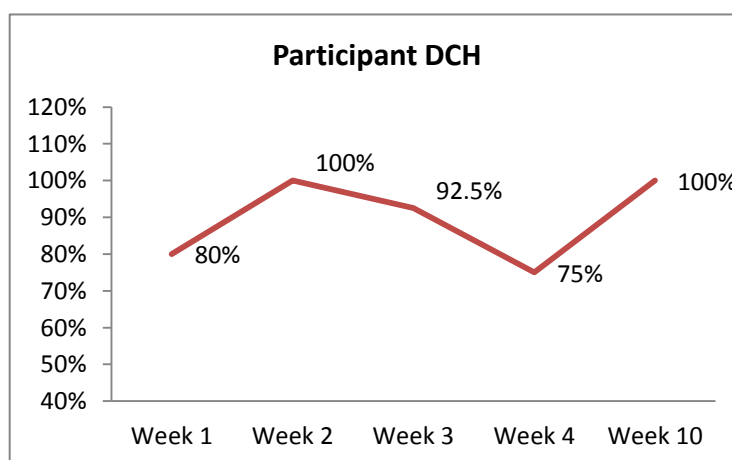


Figure 38-8: Participant DCH's knowledge optimisation transition

Therefore, this suggests that DCH's knowledge was successfully optimised as he was able to: demonstrate 'remembrance' to indicate that he did not just receive the information provided by the paper-based tool but he also acquired the knowledge by assimilating it; demonstrate some 'understanding' to indicate that he had retained some of the knowledge; and demonstrate 'application' to indicate that he could apply some of the knowledge acquired. This implies that the knowledge optimisation that occurred to DCH, which was facilitated by his consistent revision of the paper-based tool, is one of the major factors that led to his perceived behavioural change in his day-to-day kitchen activities.

In summary, these reveal that even when participants have the same treatment, the outcomes for each individual is not necessarily the same as the different skills and attributes of each person plays an important role in shaping how the app or paper-based tool would influence them.

39 APPENDIX AD – MORE DETAILS ON TOOLS AND TECHNIQUES

39.1 Semi-Structured Interviews

The use of interviews was incorporated in this research in the form of semi-structured interviews as the primary data source. This data collection technique can be categorised into three; structured, semi-structured and unstructured (Cairns and Cox, 2008). According to Cairns and Cox (2008), structured interviews are guided by a pre-prepared set of questions, in an open or closed style, in a manner that is similar to a survey or questionnaire. They also argued that the more structured an interview is, the easier it is to analyse and that structured interviews may not put participants at ease, thus hampering important revelations that may occur in a less structured setting.

Semi structured interviews, while similar to the structured ones in that it presents a base structure with open ended questions, but differs as it allows unseen perspectives to be explored (Meyer, 2001). According to Longhurst (2003), semi structured interviews occur when an individual, the interviewer attempts to elicit information by asking another person questions; thus causing a verbal interchange. It is called semi-structured because the interviewer usually prepares a list of questions for the interview session; though the conversation unfolds in a way that gives the interviewee the opportunity to discuss related issues which they feel are important to the discourse. Fylan (2005) has also argued that semi structured interviews vary with participants as some could be simple and orderly while some others could be open enough to touch many related areas before the questions are finally answered.

Semi structured interviews are very useful when an investigation concerns finding out why something occurs. It is also useful when conducting an investigation on complicated research questions by exploring contradictory statements provided by participants; thus helping to provide insights into knotty issues (Fylan, 2005). Perhaps more important is the fact that this method provides a great level of flexibility in the design, refinement and the actual conduct of the interviews (Horton et al., 2004) as opposed to structured interviews. Hence, semi structured interviews have been adopted in this study rather than structured interviews in accordance with the philosophical assumptions underpinning this research as stated in section 3.2.

39.2 Focus Groups

Focus group is a data collection method whereby data is generated via communications occurring in group discussions. Group interactions are used as part of the method as it helps in exploring the knowledge and the experience of the individuals in the group in a bid to determine and understand their actions, the rationale behind their actions and their thought processes (Kitzinger, 1995). Focus groups are particularly advantageous as it draws upon the attitudes, feelings, experiences, beliefs and emotions of the respondents while revealing multiplicity of views in a way that is not feasible when other research methods are used (Gibbs, 1997). It provides multiple understanding and meanings while giving multiple explanations for the actions of the group participants. Hence, it helps to provide a better understanding of the attitude-behaviour gap (the gap between what people say and what they actually do) (Lankshear, 1993).

Having reviewed studies concerning the ideal group size, Moreland et al. (2013) argued that many of the suggested group sizes do not have sufficient scientific justification and that the ideal group size should be based on these three paradigms. First, observing social interactions in public places reveals natural group sizes suggesting that people avoid groups that are too large (more than five or six) or too small (two or three) (Wesley Burgess, 1984, Desportes and Lemaine, 1988). Second, creating artificial groups with different sizes and identifying those with fewer problems; thus revealing that people least complained about groups of five people (Bray et al., 1978, Slater, 1958). Third, asking people about their ideal group size, this led to many people preferring groups of twelve people (Buys and Larson, 1979, McPherson, 1983). While these arguments do not seem consistent, it does seem that a group of six people may be optimal. However, it is imperative to prepare for unforeseen circumstances; hence an addition of three people should suffice. This suggests a group of six to nine people.

In this study, focus group was a primary data collection method in phase two of the research, with nine participants in a discussion session. The focus group was conducted in October 2015 and it ran for approximately one and a half hours. All nine participants were provided with an information sheet (Appendix R) and consent form which outlined the research. The signed consent form was obtained from all participants. All participants were provided with cheese, wine and a movie voucher as an acknowledgement of their contribution; thus providing a relaxed and friendly

environment rather than a 1:1 setting in a laboratory which could cause a risk of the Hawthorne effect (Brown et al., 2011). This approach helped militate against and/or minimise the existence of the Hawthorne effect. The focus group was run by an experienced moderator with an observer present to take notes as recommended by Wong (2008). At the beginning of the session, participants were briefed on the purpose of the focus group and were assured of the confidentiality of their contribution. All participants provided information about their age, gender, highest level of education, smartphone use and dietary intake in written questionnaires prior to the focus group session.

Next, participants were presented with three different scenarios (one for each app) and were asked to locate information on the app so as to answer closed ended questions – *Quantitative Information Task*. Following this, there was a group discussion, which was guided by the card sorting technique. The discussion was recorded and later transcribed, as a secondary data collection mode, in order to verify the results of the card sorts. The session ended with a *Qualitative Information Task*, in which participants were not allowed to use their mobile phones anymore but they were asked to refer to the same scenarios so as to answer open ended questions on knowledge acquired through the app about an hour earlier.

This method of assessing consumer understanding draws on the Consumer Understanding Test (CUT) methodology developed by Danone (see Rogeaux et al., 2010). The CUT methodology combines a qualitative and a quantitative approach using open ended and closed ended questions respectively. This helps to investigate how health claims or in this case food safety information is understood in the context in which it appears in a real-life exposure situation. One of the ways in which safe food management information appears in real life situation is through the use of mobile applications. Whilst CUT, which has been utilised by Grunert et al. (2011), is developed as a web-based approach, the core concepts are deemed useful to the nature of this research. The data generated from the open and closed ended questions were manually analysed and regarded as secondary data which was used to corroborate the findings of the focus group card sorting technique.

39.3 Document Reviews

Document analysis is a systematic process that is used in reviewing electronic or printed materials (Bowen, 2009). It requires the examination and interpretation of data in order to understand and develop empirical knowledge about a certain phenomenon just as other qualitative methods do (Rapley, 2008). According to Atkinson and Coffey (1997), documents are social facts which are developed, disseminated and used in social organising ways. These are in form of texts or images that have been produced without the intervention of the researcher. Examples of the forms of documents that can be used in a study include organisational or institutional reports, questionnaire data, various public records, books, brochures, newspapers, journals, minutes of meetings, advertisement and others (Bowen, 2009).

As a research method, document analysis is particularly applicable to qualitative case research which produces rich description of a single phenomenon (Stake, 1995). Consistent with this argument, Merriam (1988) has argued that ‘documents of all types can help the researcher uncover meaning, develop understanding, and discover insights relevant to the research problem’ (p. 118). Angers and Machtmes (2005) incorporated the use of document analysis in the qualitative case study they conducted.

39.4 Card Sorting

The card sorting technique is a research approach that has been widely used in various fields such as Knowledge Engineering, Software Engineering, and Web Site Design (Zimmerman and Akerelrea, 2002). Nielsen and Sano (1995) has regarded it as a usability technique that is commonly used to discover users’ mental models. This technique helps to organise diverse pieces of information or concepts and it involves providing a certain set of users with a group of cards (Faiks and Hyland, 2000, Sakai and Aerts, 2015). Information that needs to be analysed is written on each card and users are asked to sort the cards with similar concepts into groups. The results can then be analysed based on quantitative (Kanerva et al., 1997, Martin, 1999, Fuccella and Pizzolato, 1999, Wood and Wood, 2008, Sherwood et al., 2003) or qualitative (Nielsen and Norman, 2000) approaches.

Proponents of this technique have indeed argued that it offers more insights into the target population's views of a certain topic (Zimmerman and Akerelrea, 2002), which is one of the objectives of this research. It has however been argued by some others (Rugg and McGeorge, 2005) that respondents are required to know about the entities named on the cards. To overcome this challenge, the qualitative approach which involves open card sorting technique was utilised in this study. Open card sorting provides users with the freedom to define labels for the different groups of the sorting results, thus "providing further insight into users' perceived meaning, priority, and interpretation of the information sorted " (Camara and Abdelnour-Nocera, 2013).

39.5 Survey or Questionnaires

First, it is worthy of note here that the terms survey and questionnaire are used interchangeably in this study. According to Gable (1994), this is a group of methods that lays emphasis on quantitative analysis such that the data generated can be subjected to statistical analysis. In this approach, data can be generated from mail questionnaires, online questionnaires, public statistics and other methods. The method seeks to discover relationships that are common across a sample population in order to be able to provide statements that can be generalised concerning the phenomenon under study across the population. An important aspect of the development of field instruments associated with this method is survey design. The design choices of the researcher affects the quality of the data collected (Sanchez, 1992, Sudman and Bradburn, 1982). Attention has to be paid to the design of questionnaires in order to eradicate all forms of ambiguity and misconceptions about the questions as it is inflexible to discoveries made during data collections.

While the method is typically associated with the positivist paradigm, it has been identified as a method useful in the pragmatism paradigm. Consistent with this, Charmaz (2006) has argued that the choice of method should be based on the research objectives and not on pre-conceived ideas about what seems more appropriate according to the philosophical paradigm. Hence, survey has been adopted as a primary data collection tool for the Advanced Stage, Phase One of this study. However, a questionnaire has only been used as a secondary data collection technique in Phase two of this study. As a

survey also serves as a method of verification rather than discovery (Gable, 1994). Therefore, the closed and open questionnaire approach has also been adopted for Phase three as a primary data collection tool. So, this research has utilised the survey tool in three areas; Advanced Stage, Phase One; Phase Two; and Phase Three.

First, in the Advanced Stage, Phase One of this study, the best worst scaling survey approach has been incorporated. Best Worst Scaling (BWS) also known as Maximum Difference Scaling (Maxdiff) is a measurement or scaling technique originally developed by Jordan Louviere and others (Louviere and Woodworth, 1991, Finn and Louviere, 1992). This technique has recently gained grounds within the food and health economics literature (Lusk and Briggeman, 2009, Erdem et al., 2012, Louviere and Flynn, 2010) but not so much in the information systems discipline. The aim of this technique is to elicit the relative weight or importance that participants allocate to attributes in (sometimes large) sets (Erdem et al., 2012).

According to Lusk and Briggeman (2009) the best worst scaling method works as follows: consumers are shown a set of attributes and are asked to select which is most important and which is least important. Consumers then have to make several repeated choices where the set of attributes varies across the questions. The responses to the questions will be used to measure the position of each attribute on a continuum of the construct of interest, in this case “importance”. Figure 3-4 provides an example of one of the best-worst questions used in the survey conducted in Phase one, stage two.

Before purchasing a food product, diverse types of information are usually considered. Please read through the following considerations and identify the **MOST IMPORTANT** and the **LEAST IMPORTANT** *information which you consider before buying a food product.*

Least Important (Tick one)	Information considered before buying food	Most Important (Tick one)
	Price	
	Use-by/Best-before	
	Brand	
	Ingredient List / Allergy Information	
	Nutritional / health benefits (e.g. low fat, reduced salt, lowers cholesterol, organic)	

	Cooking instructions / Portion Information	
	Country of origin	
	Certification logo/Symbol (e.g. “RSPCA approved”)	
	Environmental impact (e.g. carbon footprint)	
	Ethical impact (e.g. animal welfare, fair trade)	

Figure 39-1: An Example of Best-Worst Question

The best-worst scaling technique has several advantages over other approaches such as the rating based methods (Erdem et al., 2012, Marley, 2009, Lusk and Briggeman, 2009, Cohen, 2003). A rating based technique provides a scale of 1 to 7, for example, with 1 being least important and 7 being the most important to respondents. One of the disadvantages of the rating based methods is that participants are not forced to make trade-offs between the relative importance of issues (Lusk and Briggeman, 2009). Another disadvantage of rating based methods is that different respondents utilise such scales differently as what represents 7 for an individual may well represent 5 for another. However, the best worst scaling techniques avoids these drawbacks by forcing people to respond with a choice (Marley, 2009, Lusk and Briggeman, 2009).

Furthermore, this approach is useful when seeking preferences over a large number of items or attributes. Ranking attributes according to their importance may become difficult as the number of attributes increases. However, the best worst scaling technique breaks this task into a more cognitively manageable size, thus making the task much easier and less prone to anomalous behaviour for the respondents (Erdem et al., 2012).

In addition, Erdem et al. (2012) argues that this approach ensures task comprehension while avoiding a scale-use bias. There is evidence that respondents utilise better judgement when evaluating preferences at the extreme rather than preferences in many levels (Marley and Louviere, 2005, Louviere, 1993). Therefore, the process of choosing only at the extreme is called “scale-free” as this eliminates the likelihood of a scale bias (Baumgartner and Steenkamp, 2001, Cohen and Orme, 2004). Unlike Likert based approaches which require respondents to map their preferences onto the scale in the same way thus causing ambiguity and differences in interpretation, the best worst scaling approach avoids such ambiguity by allowing respondents to make selections based on the most and least important items within a set (Erdem et al., 2012).

In this study, the best worst scaling technique, which is considered a novel methodology within the information systems discipline, is adopted for aspects of the survey conducted in the Advanced Stage, Phase One of this research. While it has been specified that the term survey and questionnaire are used interchangeably in this study, one way to distinguish between how they have been used here is that the term survey was typically used in Advanced Stage, Phase One: Investigating knowledge Gaps – Consumer Perspective while the term questionnaire was typically used in Phases Two and Three.